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ROYAL ARMY MEDICAL CORPS

TRAINING PAMPHLET
No. 3

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By Command of the Army Council,

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ROYAL ARMY MEDICAL CORPS TRAINING

SECTION I.—THE HUMAN BODY

CHAPTER 1

AN OUTLINE *

1. The microscope shows that the human body is made up of countless small cells. Indeed all living things—both animals and plants—are made of cells; and these may be regarded as the bricks that form the living structure.

But, unlike a brick, each cell has a life of its own.

Life means activity; and in all live cells, even when they are not obviously moving or growing or dividing, chemical changes are always taking place. This activity—like the activity of an internal-combustion engine—is impossible without (*a*) a supply of *oxygen,* and (*b*) a supply of *fuel.* A cell, like an engine, must also have means of getting rid of any parts of its fuel (food) that it cannot use (*waste-products*).

The simplest animals and plants consist of single cells, drifting about in ponds or the sea. Their very thin walls allow oxygen and food to come in, and waste-products to go out.

But when an animal, instead of being one cell, or a few hundred, is composed of thousands of millions of cells, the problem of keeping them all alive is far more difficult. Instead of being surrounded by water, or even by air, most of the cells of the human body are surrounded by other cells. Hence elaborate arrangements have to be made to ensure that every one of them receives the oxygen and fuel it needs for its work, and is also able to get rid of its waste.

2. The blood.—If a man is healthy and is properly fed, his blood contains in liquid form all the food the cells require. His heart pumps the blood through a system of pipes (*arteries*)

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* This chapter can be read as an introduction, but the beginner need not try to master its contents completely. He can return to it later when he wants to draw together the knowledge gained from studying the parts of the body separately.

which branch repeatedly until they form a network of very small thin-walled tubes (*capillaries*) which carry the food into the neighbourhood of every cell in the body, just as the runnels of an irrigation scheme take water to every plant in the fields. Besides liquid food, the blood also contains small red discs (*red corpuscles*) each of which carries a load of oxygen. Stationary cells needing oxygen can take it from one of these corpuscles, which arrive in a continuous stream through the arteries. The blood does not actually come into contact with the cells, for it mostly remains in its tubes ; but it passes food and oxygen through the thin walls of the capillary tubes into a fluid called *lymph* in which the cells are bathed.

As it travels through the capillaries, the blood not only nourishes the cells with food and oxygen but also removes their waste-products—especially *carbon dioxide.*

The blood cannot, of course, return to the heart by the way it came, and from the network of capillaries it is gathered into larger tubes (*veins*). Like rivers receiving tributaries, these get bigger as they approach the heart.

3. Respiration.—When it reaches the heart through the veins, the blood is no longer the same as it was when it was pumped out through the arteries ; it has exchanged some of its oxygen (which keeps cells alive) for carbon dioxide (which eventually kills them unless it is removed). Before going round the body again the blood must get rid of its carbon dioxide and take in more oxygen.

For this purpose it is pumped through a special set of capillaries which are exposed to the air. These capillaries are in the *lungs*, which occupy most of the chest.

The inside of a lung is like a sponge, made up of thousands of little caves or cavities. Every time the chest expands (*inspiration* or in-breathing), a breath of fresh air passes through the nose or mouth, down the windpipe, and into these cavities. The blood, as it flows in the thin partitions between the lung cavities, gives up its carbon dioxide to the air, while its red corpuscles take in oxygen. Every time the chest contracts, the air in the lungs—which is no longer fresh, for it now contains the waste-product, carbon dioxide—is breathed out again (*expiration*). The blood, now purified, returns to the heart and is again sent out on its main journey through the arteries. This circulation of the blood is illustrated in Fig. 1.

A man at rest inspires fresh air, and expires air containing carbon dioxide, about 14–18 times a minute. The heart, which contracts (beats) on the average about 70 times a minute, keeps the blood flowing through all the capillaries of the body, including those in the lungs, during the whole of life.

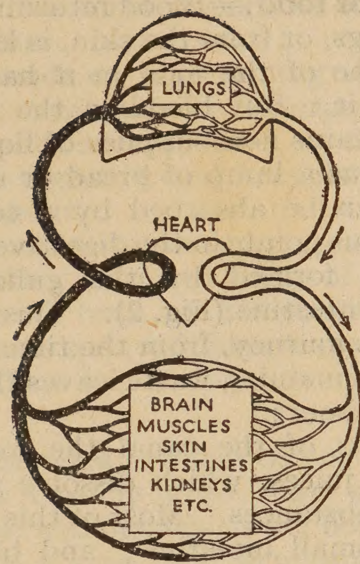

FIG. 1.—CIRCULATION OF THE BLOOD.

In passing through the lungs the blood is purified by exchanging carbon dioxide for oxygen.

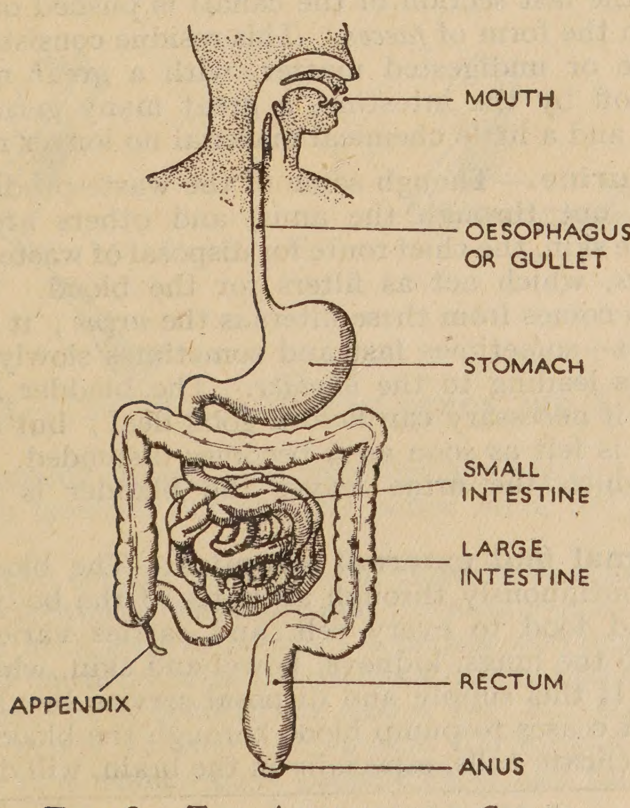

FIG. 2.—THE ALIMENTARY CANAL.

4. Circulation of food.—Blood returning through the veins from the arms or legs, or from the skin, is less rich than arterial blood, because some of the food in it has been removed by cells which needed it. But blood in the veins from the gut is richer, for it contains new supplies of liquid food.

Solid food, such as a lump of bread or meat, has to be dissolved before it can be absorbed by a cell. The dissolving takes place at various points in the digestive tube (or *alimentary canal* *), which is formed by the gullet, stomach, small intestine and large intestine (Fig. 2). This tube is some 30 feet long, and the food's journey, from the time it enters the mouth until the time any remaining waste leaves the body at the *anus*, usually lasts 24–48 hours.

In different parts of the canal the food is acted on by different digestive juices, which dissolve it and split it into simpler chemical substances. Most of this digestion is done in the stomach and small intestine ; and blood going through capillaries in the walls of the small intestine becomes especially rich in liquid food.

Blood passing through capillaries in the walls of the large intestine picks up most of the water remaining in the contents of the gut. The fairly dry residue arriving in the *rectum* (which is the last section of the canal) is pushed out through the anus in the form of *faeces*. This residue consists of a little indigestible or undigested matter, with a great many dead cells cast off by the intestine, a great many germs (mostly harmless), and a little chemical material no longer required.

5. The urine.—Though some of the waste-products of the body pass out through the anus, and others are excreted through the skin, the chief route for disposal of waste is through the *kidneys*, which act as filters for the blood. The waste fluid which comes from these filters is the *urine* ; it drips from the kidneys—sometimes fast and sometimes slowly—through small tubes leading to the *bladder*. The bladder has elastic walls, and if necessary can hold a good deal ; but a desire to pass urine is felt as soon as it becomes distended. The tube through which the urine leaves the bladder is called the *urethra*.

6. Internal and external supplies.—The blood, in circulating continuously through all parts of the body, supplies oxygen and food to every cell, and carries various waste-products to the lungs, kidneys, bowel and skin, which get rid of them. If this supply and disposal service breaks down—if the heart ceases to pump blood through the blood-vessels—the more delicate cells, especially in the brain, will die in a few

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* Alimentary means " nourishing."

minutes ; and when the most important cells have died, the death of all must follow.

Life therefore depends on maintaining the internal supply services. But there must also be external supply services : animals and men (unlike trees) have to find or catch their food before they can digest it, and for this purpose they have to be able to move about.

A human being is not a stationary mass of cells, all more or less alike. He is rather a united army of cells equipped for complicated operations both of defence and offence. This army is organized into many different specialist units ; and all cells, like all soldiers in a modern army, are specialists in their jobs.

7. Bones and muscles.—Some of the cells take in lime (calcium) salts and thereby grow hard and almost stony. These form the *bones*, without which the body would be flabby and ineffective. But a very rigid structure would be equally unsatisfactory. Hence the spine, which acts as the central support, consists of a large number of small bones (*vertebrae*) jointed together so as to bend forwards, backwards or sideways. The arms and legs are attached indirectly to the spine in such a way that they can move freely, and there are many joints in each limb.

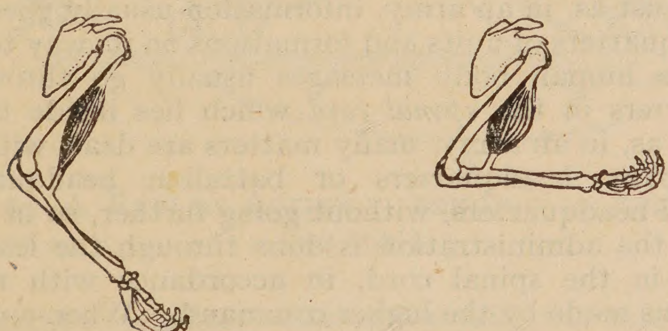


FIG. 3.—THE BICEPS MUSCLE BENDS THE ELBOW.

All movements are made by contracting a *muscle* ; and most muscles run between two or more bones which are connected by a joint.

The muscles consist of bundles of thread-like cells or fibres, arranged lengthways, which are able instantaneously to change their shape from long to broad. A person who demonstrates the size and hardness of his biceps has a feeling that the muscle swells because he is bending his elbow (Fig. 3) ; but actually the elbow bends because the muscle fibres—and therefore the muscle as a whole—have become short and thick instead of long and thin.

Power to alter the shape of the muscles, and thus alter the relative positions of any bones in the body, enables a man or an animal to move over the ground and collect or catch his food.

Compared with animals, man's upright position is both a disadvantage and an advantage. He cannot run as fast as the dog or horse with their four legs. But, on the other hand, he has two limbs (his arms) always free for other activities, from throwing stones to building aircraft or writing letters. Man at his best is only moderately swift and moderately strong, but his hand is an instrument of precision worth far more than speed or strength. Human development would have been impossible without this complex system of bones and joints and muscles forming flexible and dexterous fingers and thumbs.

8. The nervous system.—Movements may, of course, be useless unless they are well directed and are co-ordinated with one another ; and if the various units of an army are to operate together they must have a chain of command and also a signals service to transmit information and orders. In the human body these are provided by the *nervous system*, and G.H.Q. is the brain. One set of nerves (*sensory*, or feeling) conveys information to the brain, and another set (*motor* or moving) conveys orders from the brain.

Few messages, however, travel directly to and from the brain. Just as, in an army, information usually goes through the headquarters of units and formations on its way to G.H.Q., so in the human body messages usually go through local headquarters in the *spinal cord* which lies inside the spine. And just as, in an army, many matters are dealt with locally, by company headquarters or battalion headquarters or divisional headquarters, without going further, so in the body much of the administration is done through the lesser headquarters in the spinal cord, in accordance with rules and regulations made by the higher command. When a particular kind of message comes in, the local headquarters, which are known as *spinal centres*, automatically issue the appropriate order, and the necessary action follows. When a particular action always follows a particular message it is described as a reflex action.

Fig. 4 illustrates a simple reflex action. A is one of the millions of nerve-endings, acting as sentries, in the skin of the foot. B is the sensory nerve running to the local headquarters (centre) in the spinal cord at C. D is a motor nerve running from the centre to a muscle E which is capable of bending the knee. If a pin is pushed into A, an impulse runs up the nerve B to the centre C. This local headquarters switches the impulse down the nerve D to the muscle, which accordingly contracts. The foot is thus removed from danger. As the

impulses have not far to travel, this reflex action takes only about $\frac{1}{30}$ sec. Information about pinpricks is passed on to G.H.Q. from the local headquarters, but as the foot is already withdrawn, the brain may not need to take further action.

If in this experiment a red-hot poker were used instead of a pin, so many nerve-endings would be disturbed that local

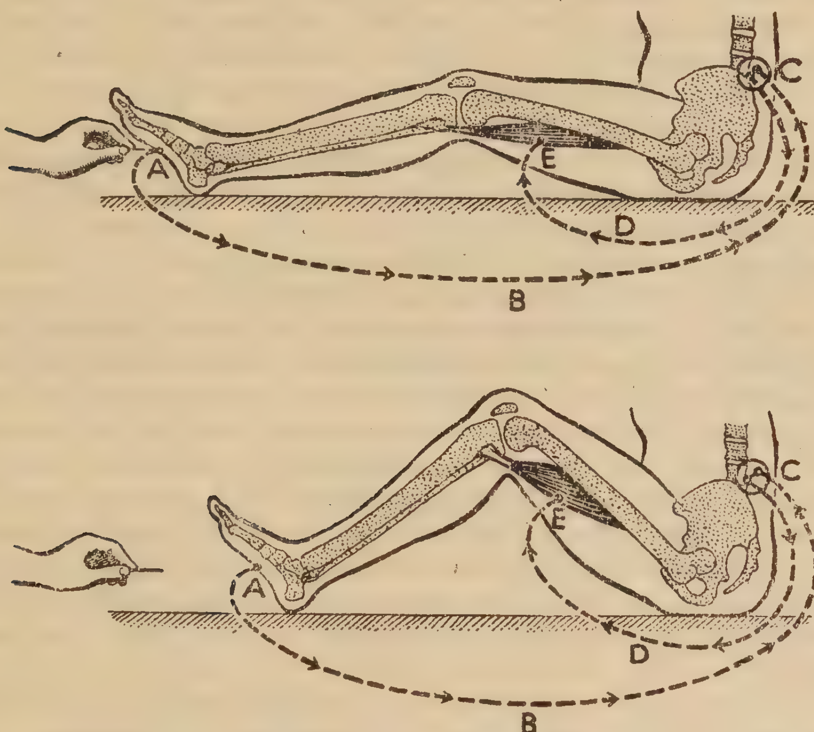


FIG. 4.—A REFLEX ACTION: BENDING OF THE KNEE. (*See* text).

action might not suffice. Messages would pour into the brain, which might send orders to many muscles and muscle groups to contract so as to get the foot away from the poker. The whole leg might move; the trunk might bend; indeed the brain might issue orders for the whole body to jump out of the way of danger.

9. Control.—People differ widely in their response to the same stimuli or shocks. They all have similar signalling systems; they all have the same arrangements for withdrawing the foot when it is pricked or burnt. But it is possible for the headquarters—the brain and lower centres—to suppress messages so that no unnecessary action is taken. The brain can issue orders that pain shall be ignored and that the foot shall remain unmoved. Control of local units by the central

command can be strengthened by training and self-discipline, and a man who has developed strong will-power may be able to prevent muscles from contracting by reflex action, unless it suits him that they should do so. If a pin or a red-hot poker hurts his foot, he does not bend his leg, or jump across the room, unless he decides that this is the best thing to do.

On the other hand, when the central command is weakened—for example, by illness, or shock, or continued anxiety, or fatigue, or certain drugs—quite a small stimulus may cause a big response. The various headquarters may become inefficient and send on all messages to all units, so that the whole army is thrown into activity every time a sentry sees a shadow; which is very exhausting. A person in this condition is commonly described as being "nervy" or "on edge."

Not only does the nervous system govern the *voluntary* movements of the heart, trunk, arms and legs, but also it governs the *involuntary* movements of the intestines, heart and other organs. These involuntary movements, which go on night and day, are carried out through a network of nerves and ganglia (centres outside the spinal cord) called the *autonomic system*. It is called autonomic, which means "self-governing," because it is independent of the will. But it is not independent of the emotions. The heart goes on beating, and the intestine goes on contracting, when one has forgotten all about them; but the state of a man's mind can considerably affect the rate of his pulse or the digestion of his dinner.

The body thus combines a system of central control with systems of local control which have varying degrees of independence. For health and efficiency the controlling centres, both central and local, must be neither too sluggish nor too excitable.

10. Endocrine glands.—The excitability or sluggishness of the nervous system is related to the activity of certain glands. Glands are collections of cells which manufacture a wide variety of substances, known as secretions, which the body needs. Thus there are glands in the skin which make sweat and grease to keep it moist, and others which make the digestive juices and deliver them into the mouth, stomach and intestines. All these have ducts—fine tubes carrying the secretions to the surface or into the alimentary canal. In addition there are a number of ductless or *endocrine* glands, such as the thyroid and suprarenals, which deliver their secretions directly into the blood-stream; and these glands all manufacture substances which stimulate activity or growth in other organs.

The chemical substances secreted by endocrine glands are called *hormones* (which means "messengers") because they

travel in the blood-stream and deliver orders to organs at a distance. They are really stimulant drugs, each of which is capable of maintaining particular kinds of cells at a high level of activity so long as it is in circulation. The function of some of them is to reinforce, or supplement, the orders given through the nervous system. In time of emergency, for example, the nervous system can secure a prolonged effect—instead of a brief one—by stimulating the suprarenal glands to deliver into the blood the hormone *adrenaline*, which so long as it is circulating will speed up the heart-beats and in other ways keep the body alert and ready for action.

It is possible for these endocrine glands to be either too active or not active enough. Lack of particular hormones gives rise to various diseases, such as myxoedema, due to lack of secretion by the thyroid gland ; and the symptoms of these diseases can often be abolished if the patient is given hormones obtained from the glands of animals, or similar substances prepared in chemical laboratories. Over-activity also causes disease : thus over-activity of the thyroid causes exophthalmic goitre. Excessive production of hormones is sometimes treated by removing part of the over-active gland, or by giving another hormone or drug with an opposite action.

The physical, mental and emotional condition of every human being—his character, growth and appearance—largely depends on the balance between the activities of his various endocrine glands. This balance, in turn, may depend on his state of mind. The health of the body and the health of the mind are very closely linked.

11. Varieties of cells.—In the endocrine glands the cells are specialists, each being occupied almost entirely in producing a particular chemical substance. But all human cells are specialists of one kind or another, and they differ correspondingly in appearance. On the outer surface of the skin the cells look like small flat plates ; in muscles they are like thick threads ; in the windpipe they have hairs (called cilia) which ripple rhythmically so as to pass *mucus* (phlegm) up from the lungs ; and in the storage depots of the body they sometimes look like signet-rings because they have been squeezed into a circlet surrounding a droplet of fat.

In size all human cells are minute, as will be seen from the scale of the drawings in Fig. 5. But the nerve-cell, which is not shown in full, is in one way an exception. Though the cell itself is small, it may have to carry impulses over considerable distances ; and it may accordingly give off one or more thin threads (*axons*) which serve this purpose. These threads, which may be insulated by fatty coverings, are sometimes several feet long, and they are gathered into bundles

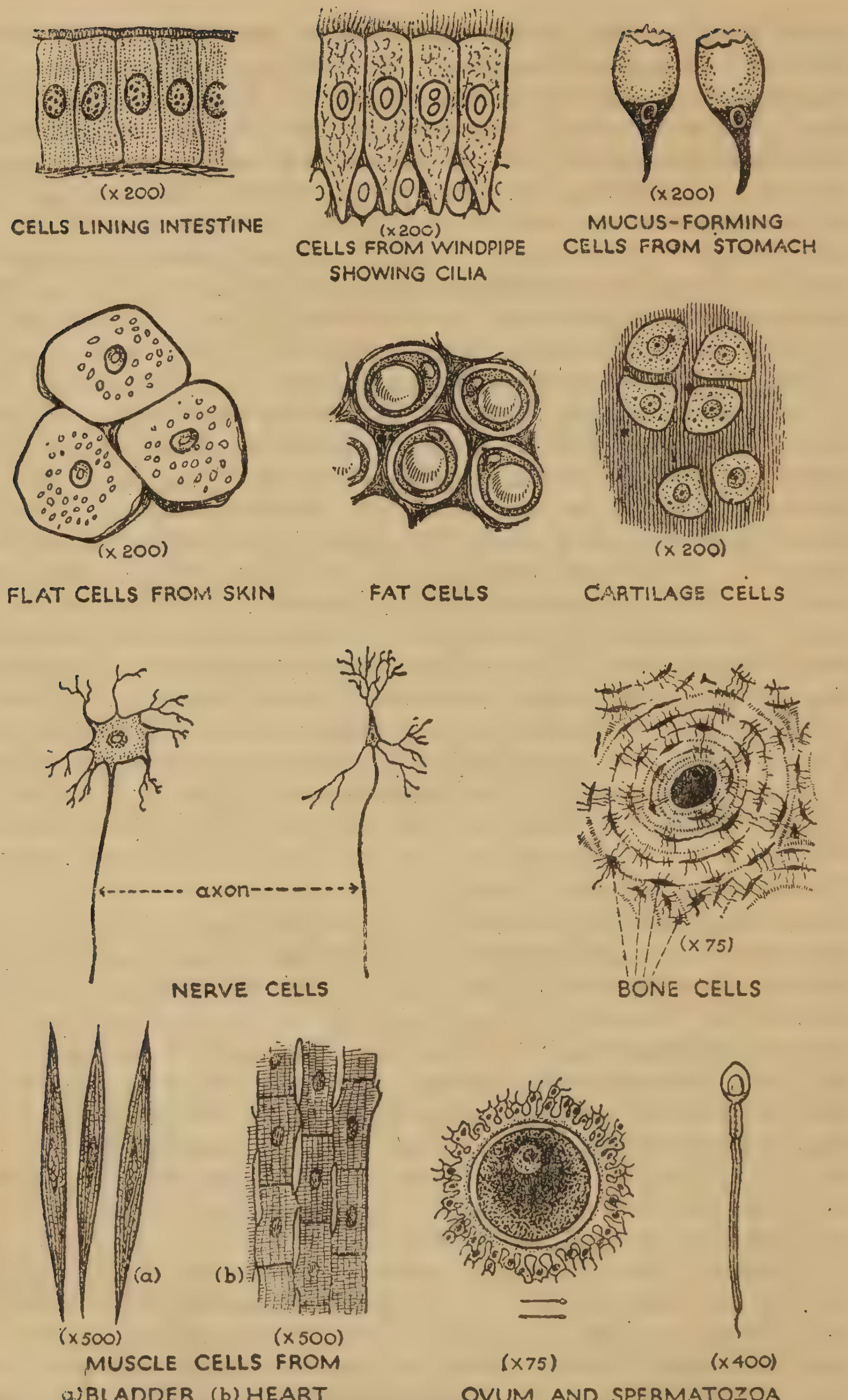


FIG. 5.—VARIOUS KINDS OF CELLS IN THE HUMAN BODY, AS SEEN THROUGH A MICROSCOPE.

Some of the drawings are 75 times as wide as the actual cell; others are magnified 200 times, and others 400 or 500 times.

to form *nerves*, just as metal wires are gathered into bundles to form electric flex or cable.

Among other highly specialized cells are those at the back of the eye which register light and colour, and those in the ear which register sound. In certain animals the eye is no more than a portion of skin which is unusually sensitive to light and shade; but in man it has developed into a complicated self-adjusting optical instrument, and the effects of light on the sensitive cells at the back of the two eyes enable him to distinguish details of colour and form in objects far and near. In the same way the cilia on certain cells in the ear vibrate in response to sounds of particular wave-length.

Through nerves from the skin the brain is informed about the warmth and pressure and wetness of the air or anything else in contact with it; through nerves from the muscles, tendons and joints it is informed about the exact position of every part of the body; through nerves from the tongue and nose it is informed about tastes in the mouth and smells at a distance; through nerves from the ear it is informed about sounds, and through the eye about colours and shapes. Thus, while awake, the brain is continuously getting information about the surroundings or environment of the body, provided by cells which have specialized in picking up particular impulses.

12. Reproduction.—The life of cells of almost all kinds is short, and in bone, muscle, brain or skin the process of cell death and replacement goes on so long as the body as a whole remains alive enough to maintain the essential supply services. Replacement normally takes place by division of a cell into two others of the same kind, and in the young and healthy this multiplication makes good—or more than makes good—the loss of cells that have died.

Certain cells, however, have specialized in reproduction, and by dividing over and over again can produce not only cells like themselves but cells of all kinds. The female ovary produces small numbers of round cells called *ova* (egg-cells); the male testicle produces immense numbers of very small active cells, with large heads and long tails, called *spermatozoa* or sperms.

A sperm encountering an ovum pierces its cell wall and the two cells fuse into a *fertilized ovum*. If this happens in favourable circumstances in the female uterus (womb), the fertilized ovum divides into two cells; each of these divides into two others, and each of these again into two. Connections are established between this growing mass and the blood-vessels in the wall of the uterus; the thousands of cells soon formed begin to take on special characteristics; and in about nine

months the new individual is ready to be born. In this short period every human being develops from a single-celled animal (the fertilized ovum) into a body composed of millions of highly specialized cells arranged in bones, muscles, nerves, glands and other tissues. Throughout childhood this infant body develops, physically and mentally, into the adult.

The structure of the adult body can now be studied in more detail.

CHAPTER 2

THE SKELETON

13. The adult skeleton consists of 206 bones, of various shapes and sizes, held together by bands or *ligaments*. Some of the joints between bones allow a wide range of movement, while others allow very little.

The bones determine the general shape and proportions of the body (Fig. 6). They form levers on which the muscles act to move the limbs or other parts of the body from one position to another. Some of them also provide protection for important organs.

14. Classes of bone.—Bones are conveniently classified according to shape, as follows :–

	Example
Long	Thigh-bone
Short	Heel-bone.
Flat	Shoulder-blade.
Irregular	Hip-bone.

15. Structure of bone.—Bones are composed of animal matter to give resilience, and lime to make them hard. Bone is stronger than oak, but lighter. In old people the proportion of lime increases, which makes their bones more brittle and so more readily fractured. The parts of bones which form joints are covered by gristle or *cartilage*. Elsewhere they are clothed with *periosteum*, a thin fibrous sheath, which contains blood-vessels and nourishes the bone.

The shaft of a long bone is a tube of solid compact bone (Fig. 7). The *medullary cavity* in the centre contains yellow bone-marrow and numerous blood-vessels. At the ends of long bones, and throughout short bones, the structure is *cancellous—i.e.* it is made of fine interlacing laths of bone forming a network with minute spaces in between. This

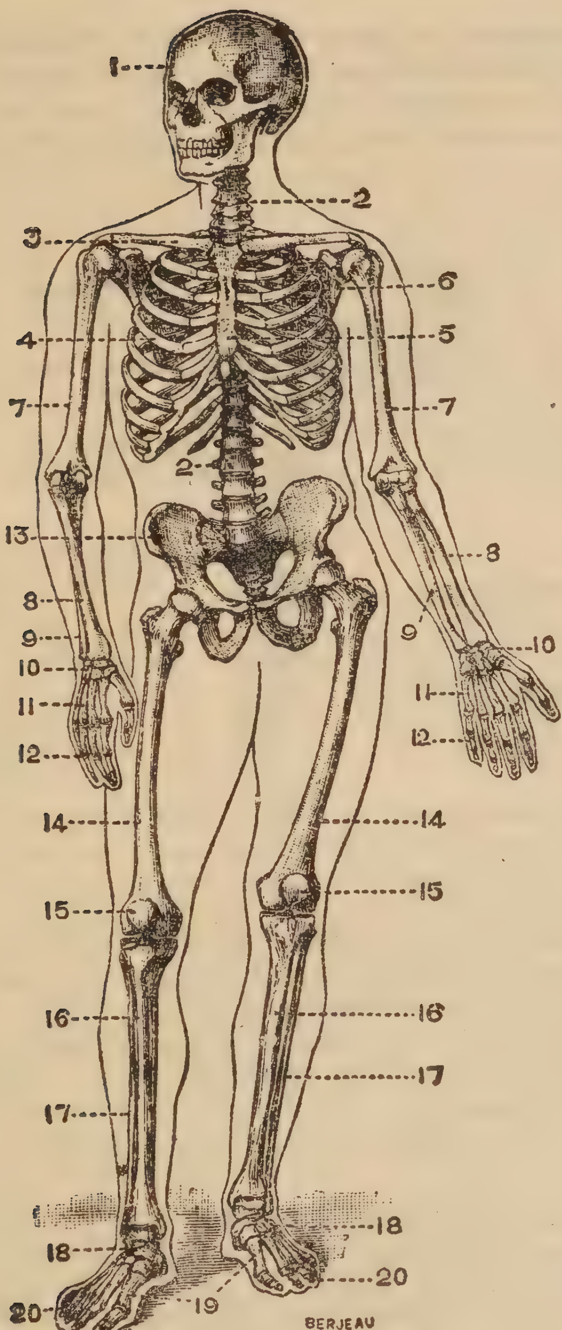


FIG. 6.—THE HUMAN SKELETON.

1. Skull.
2. Spine formed of vertebræ.
3. Clavicle, or collar-bone.
4. Ribs.
5. Sternum, or breast-bone.
6. Scapula, or shoulder-blade.
7. Humerus.
8. Radius.
9. Ulna.
10. Carpus, or wrist bones.
11. Metacarpal bones.
12. Phalanges, or finger bones.
13. Innominate, or hip-bone.
14. Femur, or thigh-bone.
15. Patella, or knee-cap.
16. Tibia, or shin-bone.
17. Fibula.
18. Tarsus, or ankle bones.
19. Metatarsal bones.
20. Phalanges, or toe bones.

makes for lightness without sacrificing strength. The spaces are filled with red bone-marrow and blood-vessels.

It must be remembered that in life all bone contains blood-vessels ; so whenever bone is broken there is always bleeding.

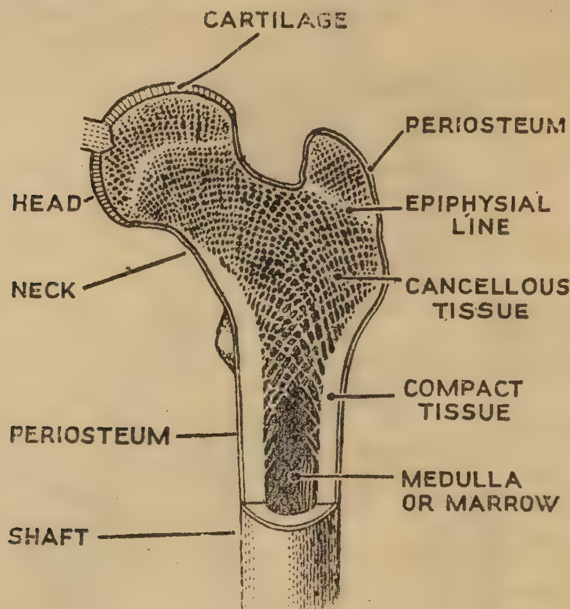


FIG. 7.—SECTION THROUGH THE UPPER END OF THE FEMUR SHOWING COMPACT AND CANCELLOUS BONE, MEDULLARY CAVITY, CARTILAGE AND PERIOSTEUM.

16. Development of bone.—At birth many of the bones consist mainly of cartilage, which is gradually converted into bone by the deposition of lime salts (*ossification*). This process is not complete in all the bones until the age of 25. Growth of long bones takes place near the ends, at the *epiphysial line* (Fig. 7). In young people this area is liable to disease and injury, which may result in stunting or irregular growth of the limb.

17. Cartilage, or gristle, is a tough, smooth, flexible, bloodless substance found in various situations where a certain amount of elasticity is useful. Thus the ribs are connected to the breast-bone (*sternum*) by cartilage, and it enters into the external ear, the nose and the windpipe. Cartilage is also found where a smooth finish is required—as on the ends of bones forming joints.

Though not readily broken, it can be cut with a sharp knife.

18. Ligaments are strong white inelastic fibrous bands which bind the bones together (Fig. 8). Though they keep them close together and prevent them from slipping out of place, they allow movement in certain directions.

19. Joints.—A joint is where two or more bones meet. It may be either movable, as in the limbs, or immovable, as in the skull.

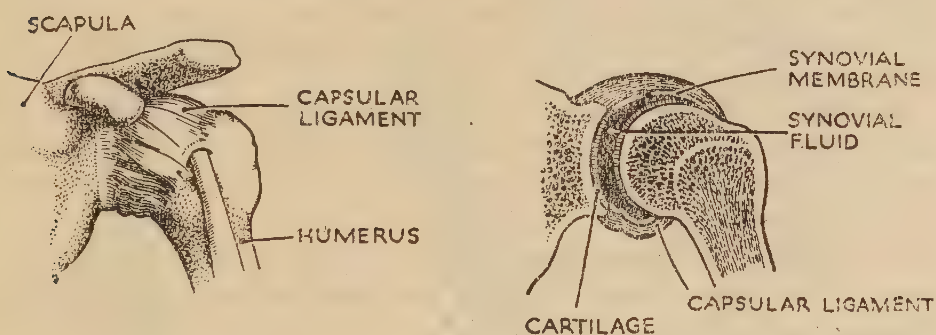
The principal kinds of movable joints are :—

Ball-and-socket joints, such as the hip and shoulder, which allow movement in nearly all directions.

Hinge joints, such as the elbow, which allow movement only in one plane.

Pivot joints, such as the joint between the first two bones in the neck, which allow only rotation.

The portions of the bones which form a joint are smooth, and are made smoother still by a covering of cartilage. The bones are held together by ligaments, and a layer of ligamentous



(*a*) (*b*)

FIG. 8.—(*a*) THE SHOULDER JOINT, SHOWING HOW THE BONES ARE BOUND TOGETHER BY LIGAMENTS. (*b*) SECTION THROUGH THE SAME JOINT, SHOWING THE CARTILAGE COVERING THE BONES WHERE THEY COME IN CONTACT.

The synovial fluid inside the joint cavity keeps it lubricated.

tissue encloses the sides of the joint. The walls of this cavity are lined by the *synovial membrane* (Fig. 8). This is a soft smooth layer which secretes a pale yellow oily fluid which keeps the bones lubricated and avoids friction.

When a joint is inflamed an increased amount of synovial fluid is poured out into the cavity, causing it to swell. This condition is known as *synovitis*. Synovitis of the knee is more widely known as " water on the knee."

20. The axis and the limbs.—The spine (*spinal* or *vertebral column*) is the central support or axis of the body, to which the limbs are attached. For purposes of description the skeleton may be divided into three parts : (1) the *axial skeleton*, comprising the bones of the skull, spinal column and chest ; (2) the bones of the *upper limb*, including the

collar-bone and shoulder-blade which attach the arm to the chest wall; and (3) the bones of the *lower limb,* including the hip-bone which attaches the leg to the spine.

The Axial Skeleton

21. The skull consists of a brain-case (the *cranium*), formed from 8 bones, and the face, formed from 14. After infancy, 21 of these 22 bones are so closely joined that the skull seems to be a single bone. The one exception is the lower jaw or *mandible,* which is attached by a hinge joint on each side of the cranium in front of the ear (Fig. 9).

The cranium forms a stout bony case to hold the brain. The upper portion (covered by the scalp) is called the *vault.* The lower portion, concealed beneath the muscles of the neck, is known as the *base.* The base is less elastic than the vault, and in places thinner. It is the part most often broken in falls on the head—" a fractured base."

Besides a number of small holes to permit passage of nerves and arteries, the base contains a large opening through which the *spinal cord,* the main nerve trunk of the body, passes down into the spinal canal.

22. The spinal column consists of 33 *vertebrae*; but as nine of these are fused to form the sacrum and the coccyx, there are only 26 separate bones. As Fig. 9 shows, it is divided into the following regions :–

The neck—cervical vertebræ	7
The back—dorsal or thoracic vertebræ	12
The loins—lumbar vertebræ	5
The rump or sacrum—sacral vertebræ	5
The coccyx—coccygeal vertebræ	4

The *vertebræ* differ from one another a good deal in size and shape: those at the top of the spinal column, which form the neck, are thin and light, while those lower down, which form the back and loins, are thick and heavy. Together they form a jointed elastic pillar which supports the trunk and skull.

Each vertebra has three principal parts (Fig. 9). A strong mass of bone in front is known as the body; a bony arch at the back forms the spinal canal; and, thirdly, attached to this bony arch are various bony projections or processes which lock the separate vertebræ together and give attachment to the ribs and the muscles of the back.

The *sacrum* is a single wedge-shaped bone consisting of 5 vertebræ fused together. The *coccyx,* situated below the sacrum, consists of a number of rudimentary vertebræ (generally four). The sacrum and coccyx together form the back of the *pelvic cavity* (Figs. 9 and 11).

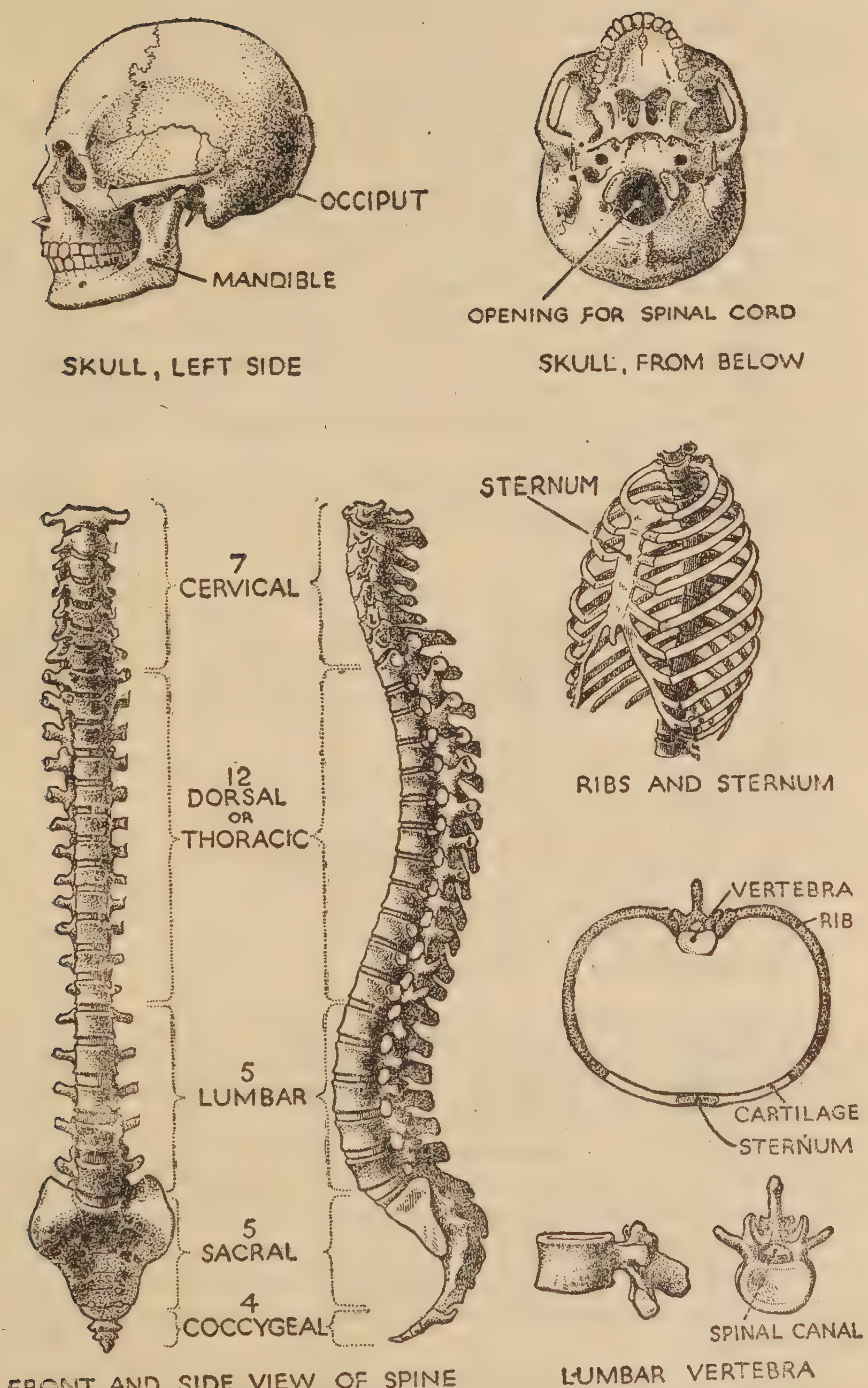


Fig. 9.—Bones of the Axial Skeleton.

23. The thorax.—The thoracic vertebræ, the ribs and the breast-bone (*sternum*) are the bony framework of the chest or *thorax*.

The *ribs* number 24, 12 on each side, connected in pairs with the thoracic vertebræ behind and, except for the last two pairs, with the sternum in front (Fig. 9).

The first seven pairs of ribs are known as the true ribs and are connected directly with the sternum, each by its own *costal cartilage*. The last five pairs of ribs are known as the false ribs, because their costal cartilages do not joint directly to the sternum. The eighth, ninth, and tenth pairs are joined by their costal cartilages to those immediately above them ; but the eleventh and twelfth pairs are, in addition, known as floating ribs, because their costal cartilages are not joined to any other, but are free.

The *sternum* is a long flat soft bone, the lower portion of which is composed of cartilage and is flexible.

The Upper Limb

24. The upper limb (sometimes called the "upper extremity") is divided into the shoulder, the arm, the forearm and the hand, and consists of the following bones :–

The clavicle or collar-bone } bones of the shoulder.
The scapula or shoulder-blade }
The humerus, the bone of the upper arm.
The ulna } the bones of the forearm.
The radius }
The carpal or wrist bones.
The metacarpal or hand bones.
The phalanges or finger bones.

25. The shoulder.—The clavicle or collar-bone (Fig. 10) is a long curved bone, situated in front at the root of the neck, which connects the scapula to the sternum, thus securing the arm to the front of the chest.

The *scapula* or shoulder-blade (Fig. 10) is a large flat triangular bone lying on the ribs at the back of the chest, to which it is anchored by powerful muscles. For the attachment of some of these muscles it has a prominent ridge (or spine) at the back. At the upper and outer part there is a shallow cavity (the *glenoid cavity*) which receives the rounded head of the humerus.

26. The arm and forearm.—The *humerus* (Fig. 10) is the bone of the upper arm. It is a long bone, having at its upper end a rounded head which works against a socket in the scapula (the glenoid cavity), thus forming the shoulder joint.

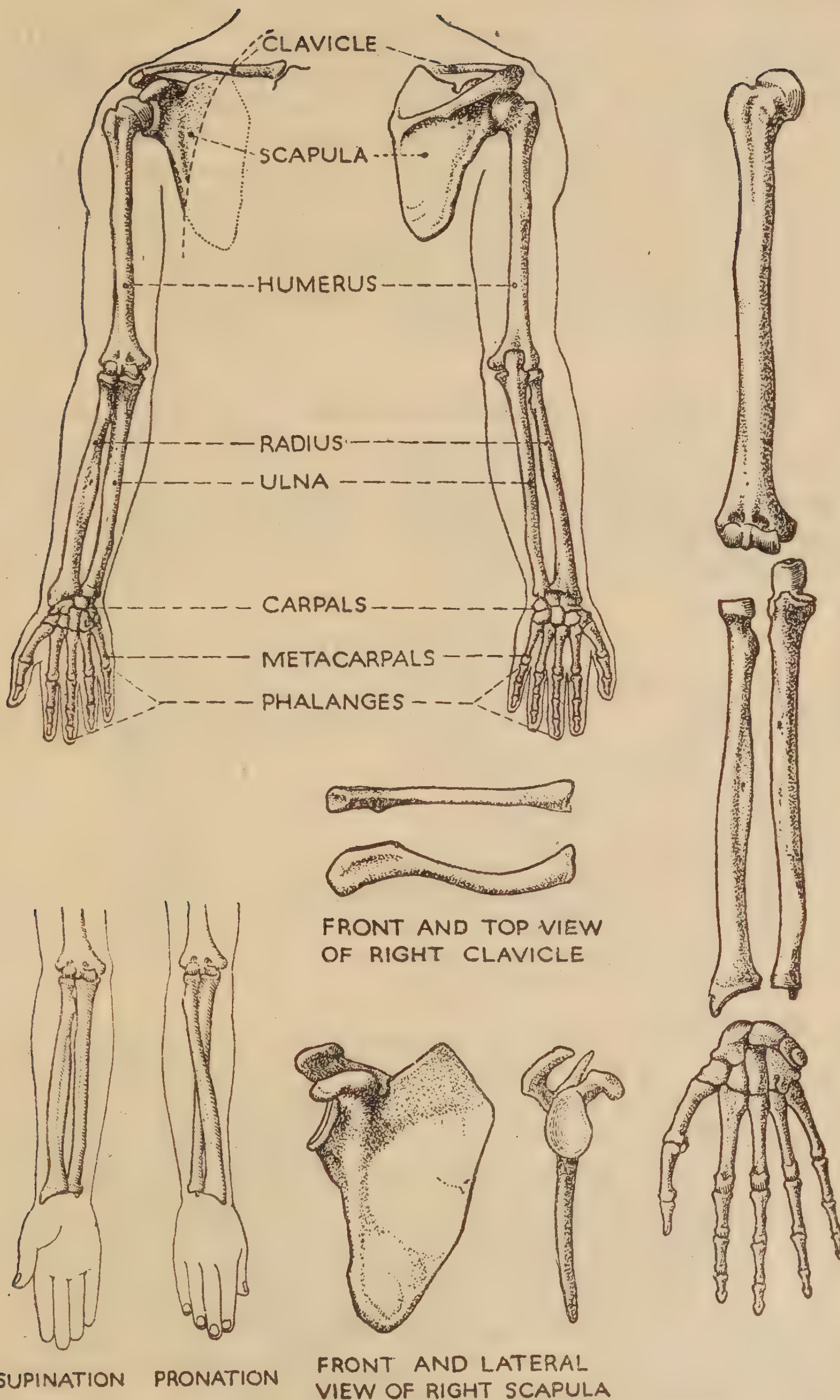


FIG. 10.—BONES OF THE UPPER LIMB.

At its lower end it has a roller-shaped surface which, with the bones of the forearm, forms the elbow joint.

The *radius* and *ulna* are the bones of the forearm. The radius extends from the outer side of the elbow to the thumb side of the wrist, and forms the main part of the wrist. The ulna extends from the inner side of the elbow to the little finger side of the wrist. At the upper end of the ulna is a projection called the *olecranon process*, which is the point of the elbow. There is a space between the radius and the ulna. By movements of the two bones on one another the hand can be turned palm forwards (*supination*) or palm backwards (*pronation*).

27. The hand.—The bones of the hand (Fig. 10) are arranged in three groups: firstly, in the wrist or *carpus* are eight small bones called the carpal bones: secondly, a row of five long bones forming the palm of the hand or *metacarpus*; and lastly, small bones named the *phalanges*, three for each finger and two for the thumb.

The Lower Limb

28. The lower limb is divided into the hip, the thigh, the leg and the foot; it consists of the following bones :–

The innominate or hip-bone.
The femur or thigh-bone.
The patella or knee-cap.
The tibia or shin-bone.
The fibula or small bone of the leg.
The tarsal or ankle bones.
The metatarsal or instep bones.
The phalanges or toe bones.

29. The pelvis.—The *innominate bone* or hip bone is large and irregular. It is attached behind to the sacrum and in front to its fellow of the opposite side, the junction of the two bones being known as the *symphysis pubis*. The two innominate bones and the sacrum together make up the *pelvis* (Fig. 11). This is a strong ring, which transmits the weight of the body to the lower limbs and forms the walls of a cavity which contains important organs, including the rectum and bladder. On the outer side and about the middle of the innominate bone is a cup-shaped cavity known as the *acetabulum*, which receives the head of the femur and with it forms the hip joint. The lower end of each innominate is thickened into a bony process called the *tuber ischii*. These support the weight of the body when sitting and protect the soft tissues from pressure.

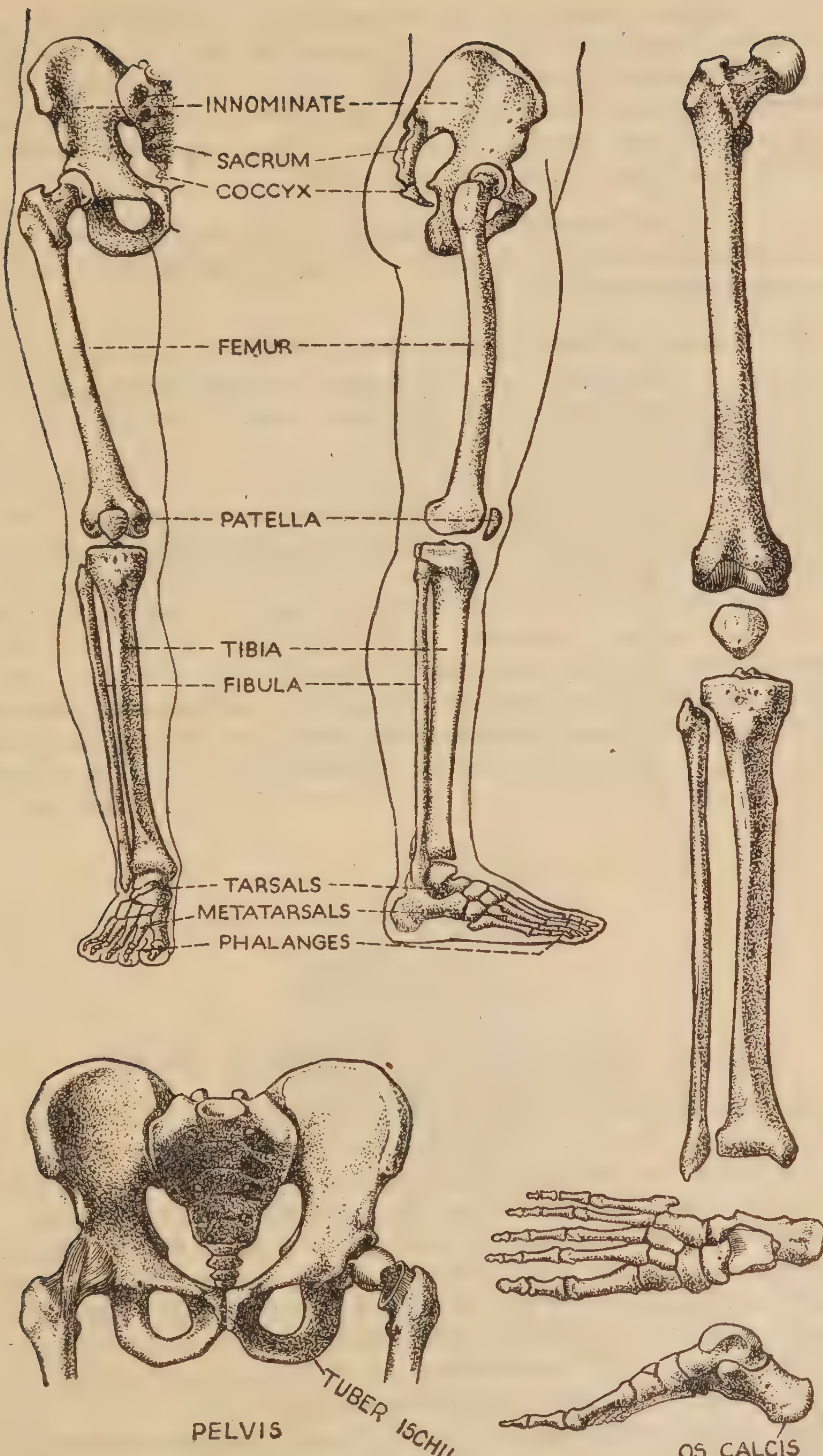


FIG. 11.—BONES OF THE LOWER LIMB.

30. The femur (Fig. 11) extends from the hip to the knee and is the largest and strongest bone in the body. At its upper end is a rounded head which fits into the acetabulum of the innominate bone, forming the hip joint; below, the bone expands into two broad prominences which, with the shin-bone and the knee-cap, form the knee joint.

31. The patella or knee-cap is a disc-shaped bone which lies in front of the knee joint. It acts as a pulley when the knee is being extended.

32. Bones of the leg and foot.—The leg, extending from the knee to the ankle, has two bones, a larger one lying on the inner side called the *tibia* or shin-bone, and a more slender bone on the outer side called the *fibula.*

The construction of the foot is like that of the hand. It has three groups of bones: the hinder part or *tarsus*, formed of seven short strong bones including the *os calcis* or heel-bone; secondly, a row of five longer bones, the *metatarsus*, corresponding to the sole of the foot and instep; and lastly, small bones named the *phalanges*, three for each of the four outer toes and two for the great toe (Fig. 11).

The sole of the normal foot is arched, so that only the ball of the foot, the outer side, and the heel-bone touch the ground (Fig. 11). This gives spring in walking. In "flat foot" the arch is flattened, and the whole sole may rest on the ground.

CHAPTER 3

THE MUSCLES AND THEIR WORK

33. The muscles form the red flesh of the body. They are made up of bundles of threads or fibres lying side by side enclosed in a sheath. Whenever these fibres contract—whenever they become short and broad, instead of long and narrow—the ends of the muscle are brought closer together. If the ends are attached to bones, these bones will be brought closer together; or if the muscle forms a circular band round a tube, such as an artery or the intestine, the bore of the tube will diminish. All movements in the body are achieved by the contraction of one or more muscles.

The muscles contract in answer to messages reaching them through nerves. Each muscle is in communication with the brain, or with a local headquarters, through a nerve which

enters its substance and gives off branches to every muscle fibre.

34. Voluntary and involuntary muscles.—Muscles are of two kinds :—

Voluntary muscles which are under the control of the will.

Involuntary muscles which act independently of the will.

Voluntary muscles carry out all the movements people can make voluntarily, such as movements of the head, trunk and limbs. Such muscles have striped fibres capable of contracting very rapidly.

Involuntary muscles carry out the remaining movements of the body, which are not under the control of the will—for instance those of the intestines, heart and blood-vessels. Except in the heart, the fibres of involuntary muscles are not striped and are unable to contract very quickly. They are controlled through the nerve system known as the autonomic (" self-governing ") system because it carries on automatically without orders from the brain.

35. Actions of voluntary muscles.—Fig. 12 shows the appearance of voluntary muscles in the shoulder region when the skin has been removed. At first sight they look like a general covering for the bones, but when the course of the

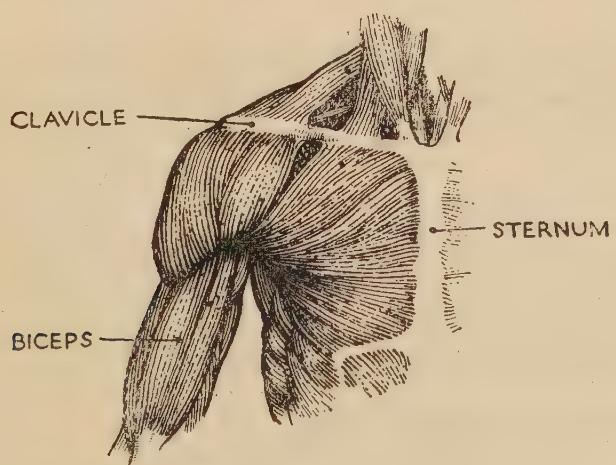


FIG. 12.—MUSCLES CONNECTING UPPER ARM AND CHEST (FRONT VIEW).

fibres is carefully examined it is found that each muscle is separate and has its own job to do. Contraction of a particular muscle produces a particular movement, which could not be made without it.

Muscles are fixed to bones in such a way that many different movements are possible. Fig. 13 shows the simple mechanical principle on which the elbow is bent or *flexed* by one muscle and straightened or *extended* by another. (When one of these muscles contracts, the other automatically relaxes). Besides bending and straightening, a turning movement (*rotation*) is

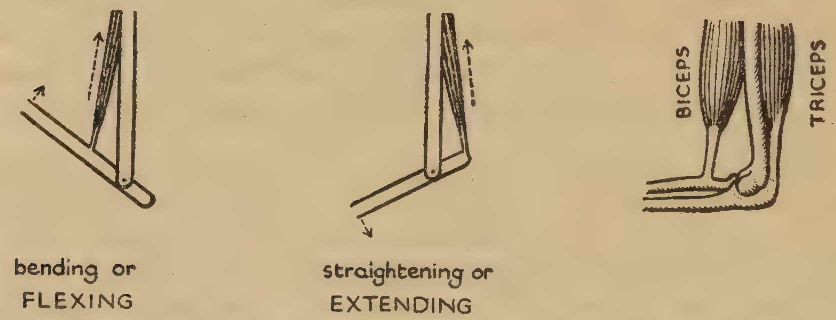


FIG. 13.—HOW THE ELBOW JOINT IS FLEXED BY THE BICEPS MUSCLE AND EXTENDED BY THE TRICEPS.

also possible at the elbow and in many other joints, and by using the right muscles the arms can be drawn close to the body or held away from it. In fact, thanks to the number and arrangement of its joints and muscles, the human body can perform with accuracy a very large variety of complicated movements.

36. Tendons.—In certain situations, such as the hands, these movements are facilitated by the formation of long leaders (*tendons*) through which the muscles exert their action from a distance. Sometimes these tendons run in grooves on the bone, which serve as bony pulleys, and often they lie in tendon sheaths containing fluid which prevents friction. Inflammation in tendon sheaths (known as *tenosynovitis*) is a not uncommon cause of pain in the wrist or ankle, and in such cases a finger placed over the painful spot can sometimes detect a grating caused by the tendon sticking to its sheath.

37. Muscular development.—Moderate exercise, together with good feeding, develops the muscles; disuse and poor feeding cause them to dwindle. Great development of muscles is seen in persons who systematically exercise them.

The effect of disuse in causing the dwindling or *atrophy* of muscles is particularly striking when a joint becomes very stiff or fixed; the limb affected may decrease to half its proper breadth. When the nerves supplying muscles are damaged, the condition of the muscles thus rendered powerless can be preserved to a certain extent by massage and movement.

Muscles can be made to contract by an electric current, and in cases of paralysis this is sometimes used to keep up their activity.

38. Expenditure of energy.—Energy is expended by the body in two ways :–

(*a*) *Internal work.*—By this is meant the work always going on in the body, even during sleep, which is necessary to maintain life.

It includes the beating of the heart, breathing, and the movements of the alimentary canal whereby the food is continually kept in motion. In these activities the body uses on the average in 24 hours the amount of energy that would be required to raise 240 tons to a height of one foot. As a by-product, the body tissues, particularly the muscles, also produce in 24 hours enough heat to raise the temperature of 40 pints of water from freezing to boiling point. This heat prevents the body from cooling down. If it is insufficient for this purpose, messages are sent to the muscles to make them contract frequently (shivering) and so produce more heat. The chemical processes of the body cannot continue normally unless a fairly constant internal temperature is maintained.

(*b*) *External work.*—By this is meant the expenditure of energy which takes place when a person engages in any muscular exertion, such as manual labour, walking or playing games. The amount of energy expended in this way depends on the amount of work performed.

The total daily loss of energy by the body is made good by the energy derived from burning up, or oxidation, of the food. A man doing heavy muscular work will require a more generous diet than a man leading a sedentary life. If this is not supplied, food stored in the body is broken down to provide the extra energy, with the result that weight is lost.

39. Supply of blood to muscles.—To maintain its life every muscle fibre, like every other cell, requires liquid food (fuel) and oxygen ; and when called upon to perform hard work—*i.e.* to contract strongly or frequently—muscles need especially large additional quantities of these chemical materials. Oxygen and fuel reach them in the blood, freely supplied to all muscles through arteries and capillaries ; and as it travels through the capillaries in the muscles this blood picks up the waste-products (chiefly carbon dioxide) formed by chemical action.

Whenever the demand of the muscles for oxygen is increased by special exertion, the rate of breathing is increased and more oxygen enters the blood. Power to make a successful physical effort, such as winning a race, largely depends on ability to provide the muscles with all the oxygen-containing blood they need for their work and for the removal of waste-products. If they do not get enough of this refreshed blood from the lungs they become tired and eventually cease to contract.

Practice and training enable runners and other athletes to increase the blood-supply of their muscles enormously at short notice, but with violent and prolonged exercise the immediate removal of *all* waste-products can scarcely be expected. To the "untrained" the feeling of stiffness caused by accumulation of waste-products in muscles is all too familiar.

CHAPTER 4

THE BLOOD AND THE LYMPH

40. Strictly speaking, blood is not a red fluid. It is a pale yellow fluid containing immense numbers of solid cells, most of which are red. The solid cells can be separated from the liquid *plasma*, just as cream can be separated from milk.

The plasma is the part of the blood that carries food round the body. As the blood flows through the thin-walled blood-vessels (*capillaries*), the food substances dissolved in the plasma pass through the vessel walls and enter the fluid (*lymph*) in which the cells are bathed. In exchange the lymph hands over any waste-products produced by the cells, and these waste-products are later removed from the plasma when it travels through the kidneys, lungs and skin.

41. The red cells.—The red cells or *red corpuscles* floating in the plasma are responsible for carrying oxygen round the body. They contain a red substance called *hæmoglobin* which easily forms a chemical compound with oxygen. When the blood is passing through the lungs the hæmoglobin picks up oxygen from the air and turns it into the chemical compound *oxyhæmoglobin*. But as soon as it reaches any part of the body where there is a shortage of oxygen it gives up its oxygen and becomes hæmoglobin again. Thus each red corpuscle, in its circular journey through the blood-vessels of the body, carries a load of oxygen from the lungs to the oxygen-hungry tissues, and then returns to the lungs for more.

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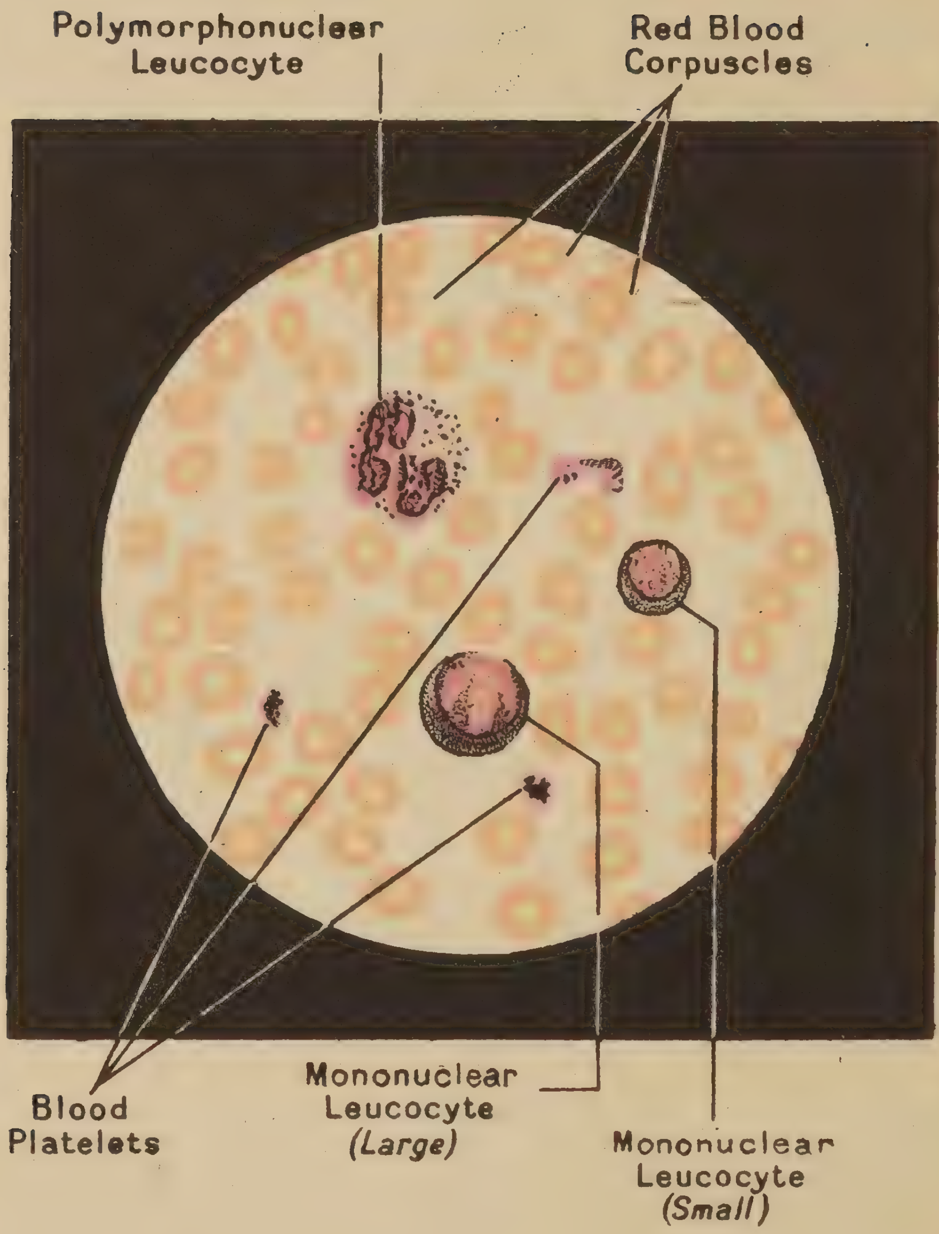

FIG. 14. RED CORPUSCLES AND WHITE CELLS IN BLOOD.

(MAGNIFIED ABOUT 600 TIMES)

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Like most of the other cells of the blood, the red corpuscles are formed in the marrow of large bones. They are shaped like discs, concave on both sides, and are so small that a single drop of blood contains about 250 million of them (Fig. 14).

Deficiency of red corpuscles or hæmoglobin is called *anæmia*. The existence or degree of anæmia can be discovered by estimating the number of red corpuscles in a given quantity of blood (a cubic millimetre) and the amount of hæmoglobin compared with normal. The total quantity of blood in the body of an average man is about 10 pints, which is more than he needs for everyday purposes and gives him a good reserve in case any should be lost. Dangerous leakage is usually avoided because blood tends to clot (*coagulate*) immediately on escaping from a blood-vessel, and clots help to close any hole made by wounding.

42. The white cells.—The white cells or *leucocytes* * also float in the plasma. Fig. 14 shows some that have been artificially stained, but in their natural state they are colourless. They are bigger than the red corpuscles, but much less numerous ; there are about 500 red cells for each white one.

Leucocytes may be regarded as a defence force, for they seize and destroy germs which manage to get into the blood, and in this way they protect the body against disease. Not only do they circulate in the blood, but by altering their shape they can also squeeze through the walls of capillaries. When germs enter the tissues (*e.g.* through a wound) large numbers of leucocytes may leave the blood-vessels in this way in order to tackle the invaders. If they are successful in the battle they presently return to the circulation. If on the other hand, they are killed by the germs they may accumulate in the inflamed area. The matter or *pus* often found in infected or inflamed parts of the body consists chiefly of leucocytes that have died in defending their position. Such pus must not, however, be regarded as harmless, for besides dead leucocytes it may contain many victorious germs.

When attacked by certain diseases, such as pneumonia, the body responds by increasing its defence force. Hence if a drop of blood is examined it may be found to contain more leucocytes than usual, and a *white-cell count* showing how far the various kinds of leucocytes have increased or decreased may reveal the nature of the illness.

Most of the white cells are formed, like the red cells, in the bone-marrow ; but some, known as *lymphocytes*, come from the lymph glands.

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* Leucocyte simply means " white cell "—from two Greek words.

43. Lymph.—Though the blood is the nutritive fluid of the body, it must be borne in mind that, except in the liver and spleen, the blood does not come into direct contact with the cells and tissues.* It is separated from them by the walls of the capillaries, which act as a filter.

Liquid food and oxygen pass through these walls into the lymph, a colourless or yellowish fluid that occupies the spaces between the cells. This lymph, as already explained, acts as a middleman: (*a*) from the blood it receives oxygen and nourishment, which it delivers to the tissues; and (*b*) from the tissues it receives carbon dioxide and other waste-products which it delivers to the blood.

Lymph is supplied to the tissues from the plasma in the capillaries, but it eventually finds its way back to the blood through special lymph vessels which resemble small veins. These unite to form the *thoracic duct* and the right lymphatic duct—long narrow tubes running up through the abdomen and chest to join the big veins near the heart. Lymph entering the veins from the thoracic duct is milky because it contains fat from the intestines.

44. Lymph glands.—In its course through the body the lymph goes through *lymph glands* which filter it and keep back poisonous material, such as germs, arriving in the lymph from the tissues. When, for example, infected lymph from a septic or festering sore on the foot enters the glands below the groin, these glands become inflamed—that is to say, they mobilize their resources in an attempt to stop the germs from advancing further. The infected glands can be felt to be swollen, and often the infected lymph vessels through which the germs have passed also become inflamed and can be seen as thin red lines running upwards from the septic sore.

45. The spleen.—The normal spleen is a soft elastic organ, weighing about 7 oz. and lying in the upper part of the abdominal cavity on the left-hand side (Figs. 26 and 27, page 50). It provides cells which help to guard the body against infection, and it breaks up red corpuscles which have become unfit for duty.

In malaria, and in many infective diseases, such as typhoid fever, the spleen increases in size. After attacks of malaria it may remain so large and soft that it is easily damaged by a knock or blow. Rupture of an enlarged spleen by a trivial injury is a not uncommon cause of severe internal haemorrhage and it calls for immediate operation.

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* "Tissue" is a name given to any collection of cells, such as those forming muscles, tendons, glands or brain. "Connective" or "fibrous" tissue holds other tissues together.

CHAPTER 5

CIRCULATION OF THE BLOOD

46. The heart pumps blood to all parts of the body through a system of tubes or *blood-vessels*. In travelling through this system the blood eventually returns to the heart, which pumps it out again. Hence the blood is continuously in movement (*circulation*) round the body.

The heart is a hollow muscular organ, about the size of a closed fist, situated behind the sternum between the lungs. Two-thirds of the heart lie to the left of the middle line, and one-third to its right (Fig. 26, page 50). It is conical in shape, with its base uppermost, and its point (*apex*) downwards and towards the left side.

It is divided into a right and left side, separated by a muscular partition so that no blood can pass directly from one to the other side. Each half is again divided into :—

(*a*) An upper thin-walled receiving chamber, the *auricle*.
(*b*) A lower thick-walled pumping chamber, the *ventricle*.

There are thus in the heart four chambers (Fig. 17, page 35).

Right auricle, left auricle.
Right ventricle, left ventricle.

Between each auricle and its corresponding ventricle, there is a flap or valve which allows the blood to pass in one direction only—namely, from the auricle to the ventricle. Each beat of the heart is in two parts : first the two auricles contract and force their contents into the ventricles ; then, immediately afterwards, the two ventricles contract and force their contents into the arteries. A short pause follows before the next beat.

47. Blood-vessels—*Arteries* are thick-walled strong elastic tubes which branch and become smaller as they get farther from the heart. Finally they divide into very small vessels with very thin walls, which are so small as to be invisible to the eye. These are the *capillaries*.

The walls of the capillaries are so thin that the dissolved nourishment and oxygen destined for the tissues can pass through them into the lymph, while the waste-products from the tissues can pass through them into the blood. The capillaries form a close network all over the body, and, gradually joining together and getting larger, they become *veins*.

The veins, thin-walled tubes, beginning thus in the capillaries, become fewer in number and larger in size until they end in the large veins which open into the heart. Veins are

provided with valves which allow blood to move only towards the heart (Fig. 15).

The arteries carry the blood from the heart to the capillaries, the veins from the capillaries to the heart. The blood travels

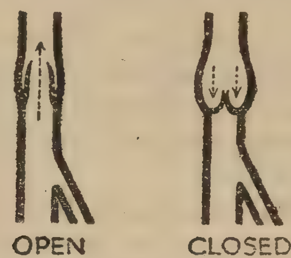

FIG. 15.—HOW THE VALVES IN THE VEINS PREVENT BLOOD FROM FLOWING IN THE WRONG DIRECTION.

rapidly in the arteries and veins, but very slowly in the capillaries, so as to give time for the exchange of nourishment and waste-products.

48. The circulation.—Blood which has passed through capillaries in the muscles, skin, brain or intestine—or any other part of the body except the lungs—must have given up some of its oxygen and needs to be refreshed. Accordingly all this blood, which enters the right side of the heart through

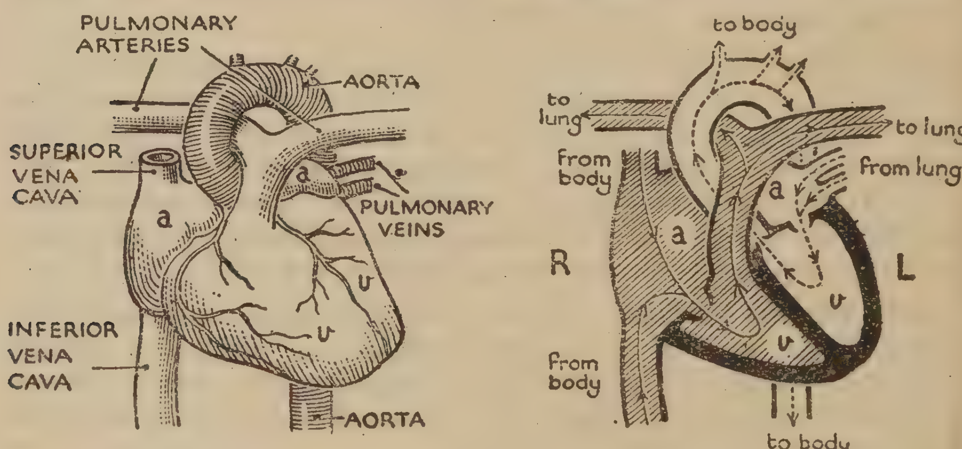

FIG. 16.—THE HEART AND GREAT VESSELS. THE CROSS-SECTION ON THE RIGHT SHOWS THE DIRECTION IN WHICH THE BLOOD FLOWS. a=AURICLE. v=VENTRICLE. R=RIGHT. L=LEFT.

the great veins (*venæ cavæ*), is pumped through the lungs before being used again. It goes from the heart to the lungs in the *pulmonary arteries*, travels slowly through the lung capillaries, and returns to the heart through the *pulmonary veins* (Fig. 16). The oxygenated blood coming back from the

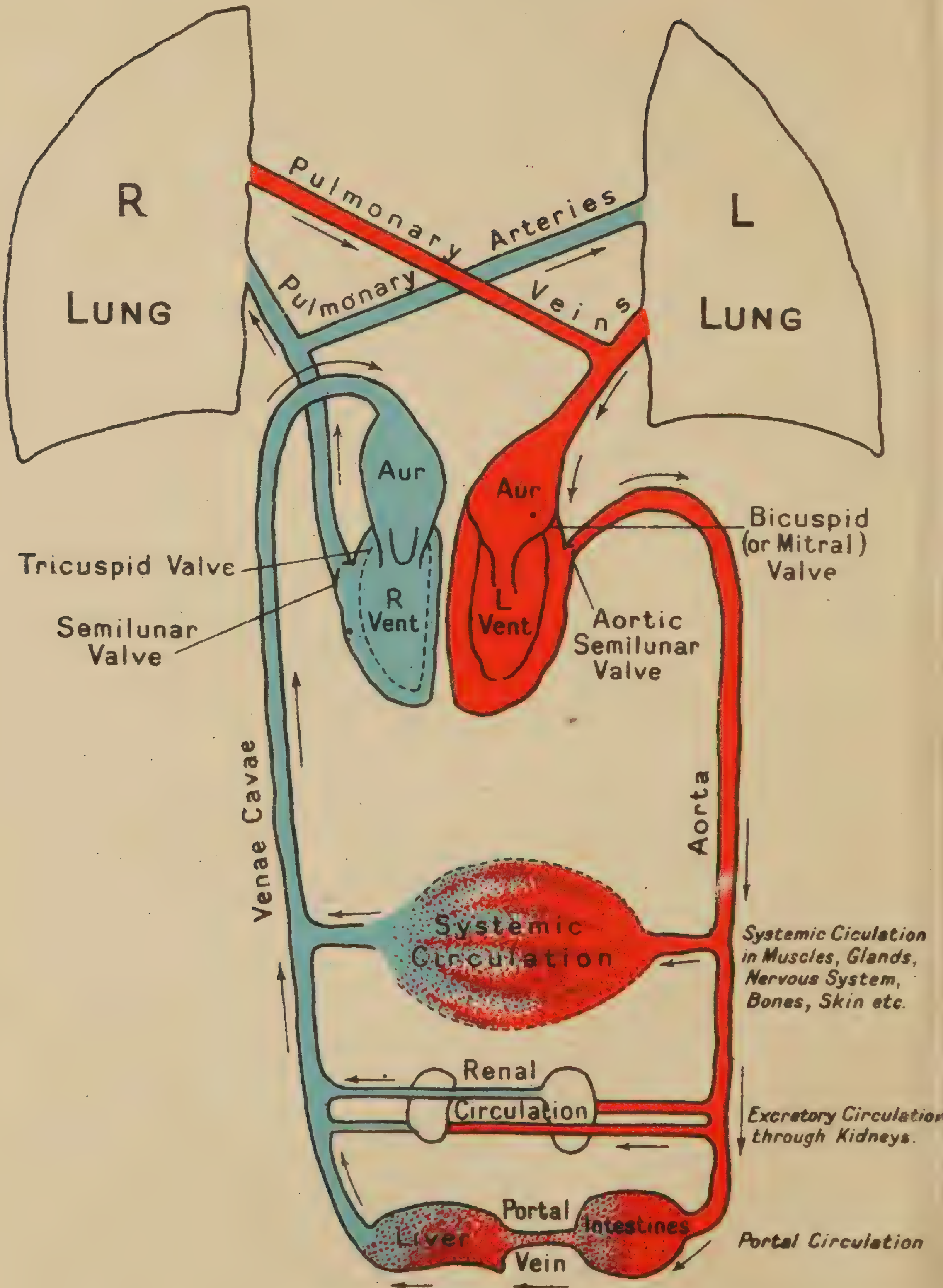

FIG 17. CIRCULATION OF THE BLOOD.

lungs pours into the left side of the heart, when it is once more sent round the body.

It will be seen that the heart really contains two distinct pumps, one serving the lungs (*pulmonary circulation*) and the other the rest of the body (*systemic circulation*).

The course of the circulation (Fig. 17) can be described in more detail as follows :—

(*a*) The venæ cavæ collect all the blood which has passed through the tissues (muscles, skin, kidneys, liver, intestine, brain, bone, nerves, etc.), and pour it into—

(*b*) The right auricle of the heart, which contracts and thus drives the blood through—

(*c*) The tricuspid valve into—

(*d*) The right ventricle, which contracts, driving the blood through—

(*e*) The pulmonary artery into the lungs, where it travels through capillaries exposed to the air.

The oxygenated blood then passes into—

(*f*) The pulmonary veins, which convey it to—

(*g*) The left auricle, which contracts, driving it through—

(*h*) The bicuspid (or mitral) valve into—

(*i*) The left ventricle which contracts, driving it into—

(*j*) The aorta, the main artery of the body, which distributes it to all parts through branch arteries which divide and subdivide, becoming smaller and smaller until they terminate in capillaries. The capillaries unite to form small veins which join with other veins, becoming gradually larger and larger until they all unite to form the venæ cavæ.

Besides the tricuspid and mitral valves, between the auricles and the ventricles, there are also semilunar valves at the beginnings of the aorta and of the pulmonary artery.

The function of all these valves is to ensure that when the heart contracts the blood is driven onwards and does not go the wrong way. Sometimes the valves become diseased and do not close completely. This impairs the function of the heart and may make the person unfit for an active life.

49. The pulse.—Although during exercise and in disease the rate may be much increased, the normal heart beats on the average about 70 times a minute. As the heart contracts, its muscles harden and the apex strikes against the left side of the chest, where the heart beat may be felt. At the same time blood is pumped into the arteries, causing a wave of increased pressure or *pulse*. This wave occurs with every

heart beat and therefore provides a simple means of counting the rate of the heart.

The heart beat can be counted in any artery near the surface ; but the radial artery just above the wrist is usually chosen, because it is readily accessible and the artery is just under the skin.

In the veins there is no beat or pulse, the force of the blood current having been spent in passing through the wide network of capillaries lying between the ends of the arteries and the commencement of the veins. The blood flows through the veins in a steady even stream.

50. Structure of blood-vessels.—Both arteries and veins have muscle fibres in their walls, but these are more numerous in the arteries. The fibres, by relaxing and contracting, regulate the calibre or bore of the vessels, and admit more or less blood to the parts they supply. These muscles are under the control of the autonomic system of nerves. Flushing and pallor are the result of increasing and reducing respectively the calibre of the small blood-vessels of the skin ; they may be caused by emotion, heat, cold, or pressure.

51. Blood-supply of vital organs.—It is important that the supply of blood to all parts of the body should be uninterrupted, and that the vital organs should receive all they need. These organs are placed in the chest and abdomen near the heart, which is the source of supply. The brain, which is a little farther off, is fed by four large arteries :—

- The carotid arteries, one on each side of the neck.
- The vertebral arteries—branches of the subclavian arteries, which themselves come from the arch of the aorta.

52. Arrangement of arteries and veins.—The aorta is the main artery of the body. Where it leaves the left ventricle of the heart it is about an inch in diameter. It forms an arch just above the heart, from which spring the great vessels to the head and upper limbs—namely, the innominate artery, on the right side, and the common carotid and subclavian arteries on the left. It then runs downwards along the left side of the spinal column and passes, through the diaphragm, out of the thorax into the abdomen, where it divides into the right and left common iliac arteries (Fig. 18). Each again divides into the internal iliac, which supplies the organs of the pelvis, and the external iliac, which is continued down into the lower limb as the femoral artery.

The subclavian artery springs on the right side from the innominate artery and on the left side from the arch of the

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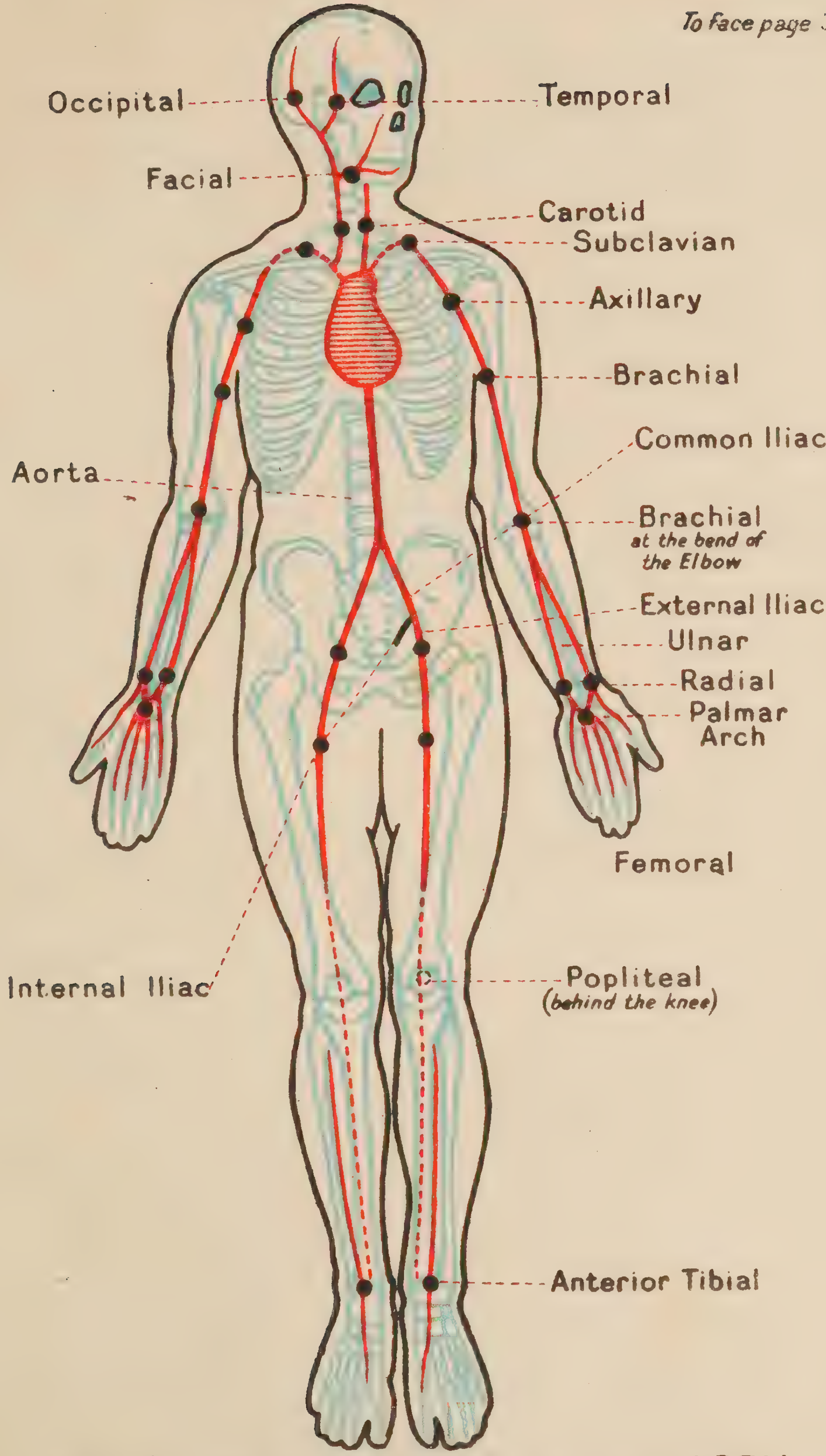

FIG 18. MAIN ARTERIES OF THE BODY.

THE BLACK DOTS INDICATE POINTS WHERE THE FLOW OF BLOOD MAY BE CHECKED BY PRESSURE WITH THE FINGERS.

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aorta. It passes out of the thorax beneath the clavicle into the axilla or armpit, where it becomes the axillary artery, which continues down the inner side of the arm as the brachial artery. At the bend of the elbow the brachial artery divides into the radial and ulnar arteries, which run down on the outer and inner sides of the forearm respectively. Having passed over the wrist (where the pulse is usually felt), they sink deep into the palm of the hand, where they unite to form the palmar arch.

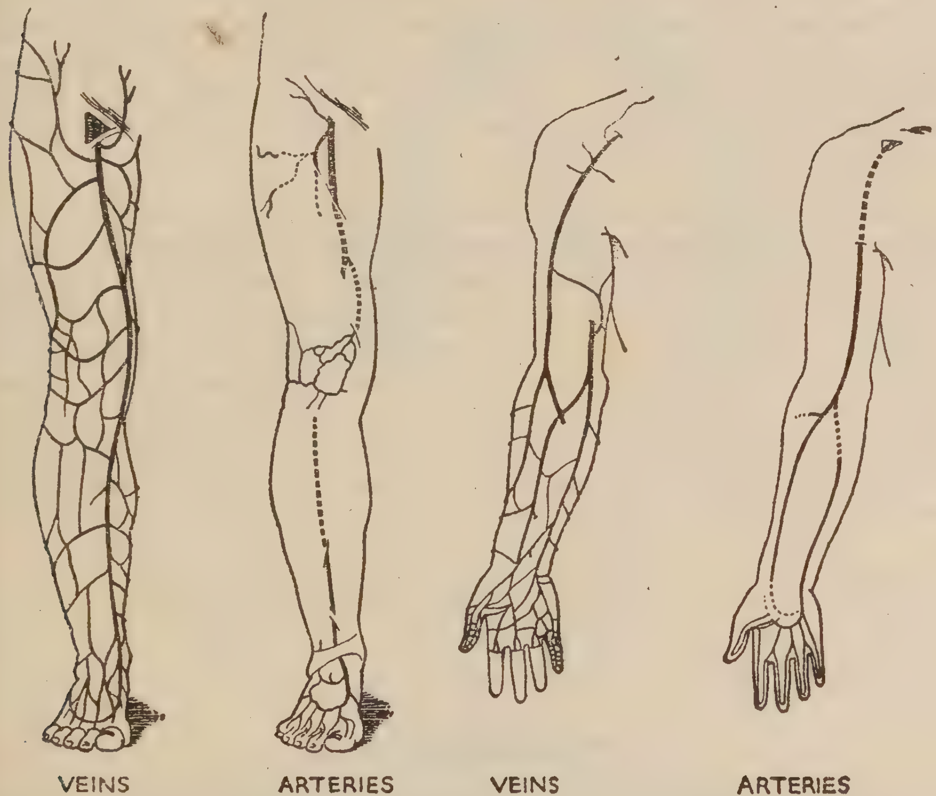


FIG. 19.—DISTRIBUTION OF VEINS AND ARTERIES IN THE ARM AND LEG, SHOWING THAT MANY VEINS LIE JUST UNDER THE SKIN, BUT THE PRINCIPAL ARTERIES RARELY APPROACH THE SURFACE.

The femoral artery is the continuation of the external iliac artery. At the junction of the limb with the trunk, the vessel lies about the middle of the thigh. At first it lies close to the surface but it soon passes under the muscles on the inner side of the thigh and thus reaches the back of the knee joint, where it is called the popliteal artery. This divides into two branches a little distance below the knee, one branch (the posterior tibial) keeping along the back of the tibia and going to the inner side of the back of the ankle, the other (the anterior

tibial) running down the front of the leg between the muscles to reach the front of the ankle. These two arteries meet in the sole of the foot, where they form the plantar arch ; this is placed under the arch of the instep in such a position that it cannot be compressed by the weight of the body in the standing position.

Veins.—Many of the principal veins run alongside the principal arteries. On the whole, however, veins are not placed so deeply as arteries. As Fig. 19 indicates, the veins of the arm and leg form a fairly superficial network, whereas the main arteries rarely approach the surface. By clenching their fists, most people can make their arm veins fuller than usual, and it is then seen that some quite large veins lie just under the skin.

53. The portal circulation.—Blood going through capillaries in the stomach and intestine collects nourishment from the digested food in them. Such blood, instead of returning direct to the heart, is first taken through the liver, which extracts and stores any of the dissolved food it requires. To make this possible all the veins carrying blood from the alimentary canal unite to form a large vein called the *portal vein,* which enters the liver and divides there. After passing through the liver, the blood is gathered into the *hepatic veins* which take it to the inferior vena cava and so to the heart.

CHAPTER 6

RESPIRATION

54. In breathing or *respiration* air is drawn in through the nose—or the mouth if this is open—and passes through the throat (*pharynx*) into the *larynx* (Fig. 20). The larynx opens into the windpipe (*trachea*) which divides into the *right bronchus* and the *left bronchus* going to the two lungs. The trachea and the bronchi are kept open by rings of cartilage surrounding them. In the lungs the bronchi branch out in all directions so as to take air to every part of the lungs.

55. The lungs are two large sponge-like organs, pinkish grey in colour, which occupy most of the chest cavity. They lie one on each side and have the heart between them. Each contains innumerable minute cavities, in which the bronchial tubes end blindly. In the partitions between these cavities there are networks of capillaries.

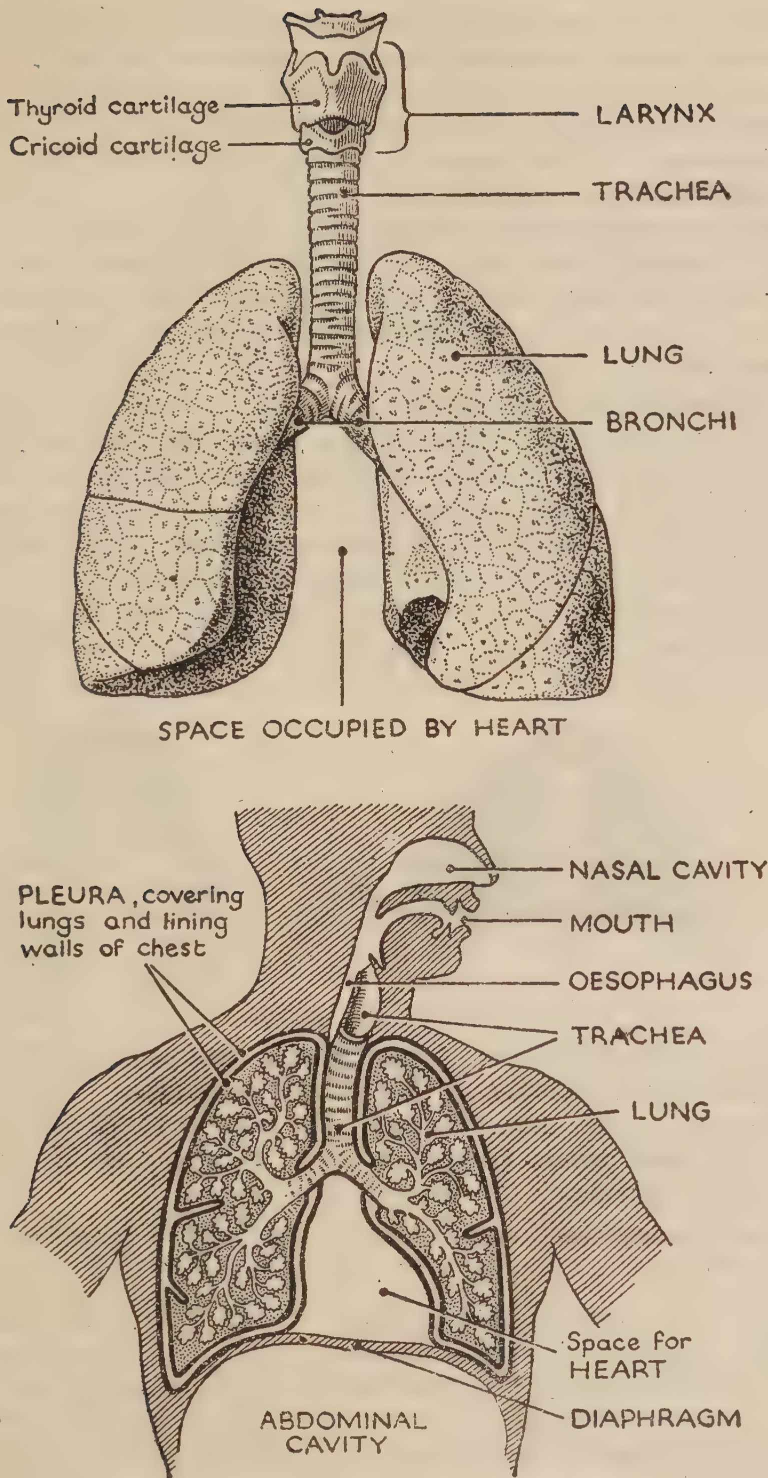


FIG. 20.—THE AIR-PASSAGES AND LUNGS.

The lower drawing represents a section through the chest, to illustrate how the bronchi branch inside the lungs.

Each beat of the heart forces blood into the capillaries of the lungs, where it comes into close contact with air. The air extracts carbon dioxide from the blood, while the blood extracts oxygen from the air ; and in this way the blood is both purified and refreshed. This can only happen, however, if the air in the lungs is frequently changed.

Some people can hold their breath for a minute or two, but by the end of this time the air in their lungs is exhausted : it will provide no more oxygen and accept no more carbon dioxide. The craving for new air then becomes so great that respiration has to start again.

56. Description of respiration.—A complete respiration consists in (*a*) *inspiration* of air into the lungs, followed immediately by (*b*) *expiration* of air from the lungs, followed by (*c*) a pause. In a healthy person at rest, a complete respiration takes place 14–18 times a minute ; but the rate is increased during exertion and in many diseases.

At each respiration, air is drawn into the lungs by expanding the chest, and is then expelled by contracting the chest. The muscle that plays the greatest part in expanding the chest

FIG. 21.—DURING INSPIRATION (LEFT) THE RIBS ARE RAISED, AND THE DIAPHRAGM BECOMES FLATTER. THE CHEST CAVITY THUS ENLARGES. DURING EXPIRATION (RIGHT) THE RIBS FALL INWARDS, THE DIAPHRAGM RISES, AND AIR IS DRIVEN OUT OF THE LUNGS.

In this drawing the changes of shape and position have been greatly exaggerated.

cavity is the midriff or *diaphragm* which forms the partition between the chest and abdomen (Fig. 20, lower drawing). When not in action it is arched upwards ; but during inspiration it contracts and becomes flatter, thus pushing the abdominal organs downwards and enlarging the chest cavity from above downwards.

Other muscles raise the ribs and at the same time carry the sternum upwards and forwards, making the chest broader from side to side and deeper from front to back. In Fig. 21

the movements of the ribs and diaphragm have been purposely exaggerated so as to show more clearly how the space occupied by the lungs enlarges on inspiration.

At the end of inspiration the diaphragm relaxes and again arches upwards ; the muscles which raised the ribs and sternum cease to act, and the chest walls fall in. The cavity of the chest is reduced in size, and air is consequently expelled from the lungs. As might be expected, however, the lungs are not completely emptied at each breath ; so only a proportion of the air is changed by a single respiration.

57. The voice.—The larynx contains muscular bands called *vocal cords*, and by contracting or relaxing these cords the size of the opening through the larynx can be varied at will. During normal respiration the passage of air through the larynx is silent ; but, with the cords in particular positions, particular sounds can be produced—just as different notes can be whistled by blowing air through partly closed lips. In this way, expulsion of air from the lungs through the larynx produces the voice, which is further modified by the lips and tongue.

CHAPTER 7

DIGESTION

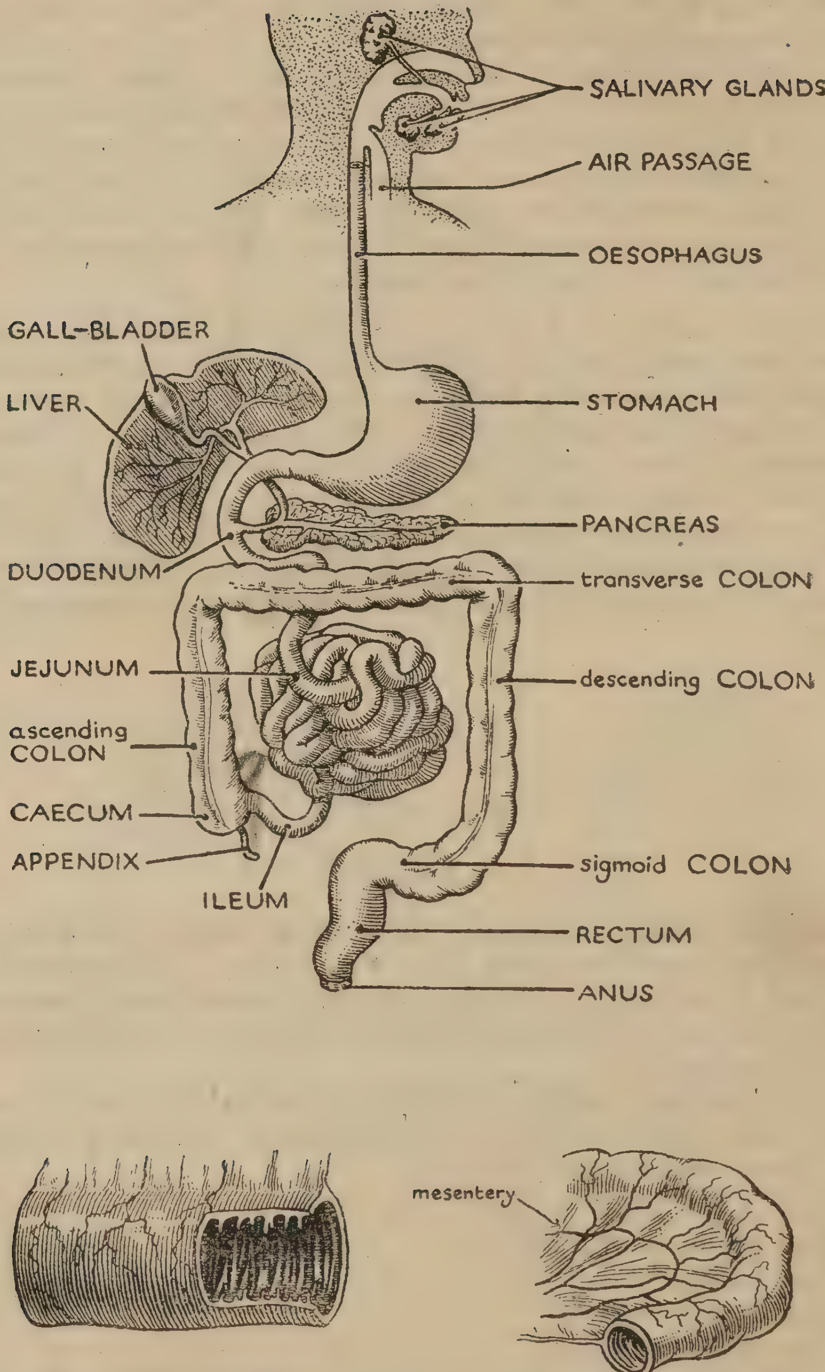
58. After being swallowed, most foods have to be digested before they can be taken into the blood. The process of digestion is carried out in the long tube called the *alimentary canal*. The food is dissolved by juices which come from various digestive glands.

The alimentary canal (Fig. 22) begins at the mouth and ends at the anus ; it is about 30 feet long. Its main sections, from above downwards, are :—

The mouth and throat.
The gullet or œsophagus.
The stomach.
The small intestine.
The large intestine.

The glands or organs which pour juices into the alimentary canal are :—

(*a*) The *salivary* glands. These secrete saliva, which is alkaline, into the mouth, where digestion of the starchy parts of food begins.



SECTION OF BOWEL SHOWING CIRCULAR FOLDS

PORTION OF BOWEL WITH MESENTERY

Fig. 22.—The Alimentary Canal.

(*b*) The *gastric* glands in the stomach. These secrete gastric juice, which is acid and acts on meats.

(*c*) The *liver.* This produces every day about two pints of bile, which helps to break up fats.

(*d*) The *pancreas.* This secretes pancreatic juice, which acts on all classes of food, continuing the action of saliva and gastric juice.

(*e*) The glands in the small intestine. These secrete the intestinal juice, which finishes the digestion of food in the intestines.

59. From the mouth to the intestine.—In the mouth the food is turned about by the movements of the tongue and cheeks, and chewed or crushed between the teeth; while at the same time saliva flows into the mouth from the salivary glands and is thoroughly mixed with the food to form a thick paste, which can then be swallowed. Swallowing is done by the tongue pushing the food into the upper part of the pharynx or throat, whose muscles seize it and pass it quickly over the top of the larynx and down through the œsophagus into the stomach.

In the stomach (which can be looked upon as a bag or receptacle) much of the digestion of the food takes place. Although the stomach begins to pass on its contents into the small intestine almost directly food is swallowed, a considerable time elapses—usually about four hours after a meal—before it is empty, and there is thus plenty of opportunity for digestion by the gastric juices.

Different sorts of glands are found at the opposite ends of the stomach, producing two different kinds of juice. Glands producing *acid* and *pepsin*, which is a digestive ferment, are situated in the first part of the stomach (the left or cardiac end), and those producing *mucin* (a lubricant) at the right or pyloric end, where the stomach joins the first part of the small intestine, known as the *duodenum.*

The acid secreted into the stomach is hydrochloric acid. Digestive troubles arise sometimes from having too much of it, and sometimes from having too little. Occasionally pain is due to an ulcer forming on the wall of the stomach or duodenum.

On leaving the stomach, the partly digested food passes into the intestine. Near the commencement of the intestine the ducts or tubes from the liver and pancreas pour their secretions into it through a common orifice.

60. Functions of the liver.—The liver is the largest gland in the body; it weighs on the average 50 oz. It lies for the most part under the ribs on the right side, but part of it extends across the middle line and over the stomach (Fig. 26, page 50).

The liver has three main functions :—

(*a*) It collects and alters food brought from the intestine by the portal vein (para. 53).

(*b*) It secretes *bile*. This is a greenish-yellow fluid which (i) helps to neutralize the acid food from the stomach ; (ii) assists in the absorption of fats ; (iii) stimulates the large intestines ; and (iv) reduces putrefaction in the bowel.

(*c*) It stores carbohydrate and delivers it into the blood-stream, as required, in the form of sugars—the fuel most easily used by the body.

Before entering the intestine some of the bile is stored in the *gall-bladder*, a small greenish pouch. This is liable to disease, when gall-stones may form inside it.

61. Functions of the pancreas.—The pancreas, which lies behind the stomach, is one of the most important glands in the body. It has two secretions :—

(*a*) An external secretion which is conveyed by a duct to the duodenum. This fluid digests proteins, fats, and carbohydrates.

(*b*) An internal secretion which takes no part in digestion but passes directly into the blood-stream and enables the muscles and other tissues to use sugar.

If the pancreas is diseased and fails to produce this secretion, sugar accumulates in the blood until it is excreted in the urine. This disease is known as *diabetes* and it is usually treated by daily injections of a pancreatic extract called *insulin*.

62. The small intestine.—The small intestine (so called because its bore is narrower than that of the large intestine) is about 22 feet long. It is attached to the back wall of the abdominal cavity by a double layer of membrane called the *mesentery* (Fig. 22, lower drawing), which allows free movement of the coils of intestine within the cavity. Between the folds of the mesentery pass blood and lymph vessels and nerves.

The small intestine is divided into three parts—*duodenum*, *jejunum* and *ileum*. The duodenum is the upper 10–12 inches and is more firmly fixed in position than the other parts. Externally there is no obvious division between the jejunum and ileum ; the former forms roughly two-fifths, and the latter three-fifths, of the small intestine, excluding the duodenum.

The intestinal wall contains circular and longitudinal layers of involuntary muscle fibres. These contract slowly at intervals, producing waves of contraction from the upper towards the lower end of the tube, and thus squeeze the food onwards (*peristalsis*).

While the food is passing along the small intestine, the dissolved nutritious portion is mainly absorbed into the blood through the walls of the capillaries which lie in the lining of the intestine. It passes thence through the portal vein into the liver, which in turn passes it into the general circulation for nourishment of the body. Most of the digested fat is absorbed by lymph vessels and reaches the general circulation not through the liver but along the thoracic duct.

63. The large intestine.—The large intestine, which is about 5 feet long, begins in a pouch called the *cæcum*, into the side of which the small intestine opens. Attached to the cæcum is the *appendix*, and it is this small blind tube that is inflamed in appendicitis.

From the cæcum the large intestine passes upwards in the right flank as the ascending *colon*, across the abdomen as the transverse colon, then downwards through the left flank as the descending and sigmoid colon. Finally, the last part of it, called the *rectum*, goes downwards in front of the sacrum and coccyx and ends in the *anus*.

The large intestine in part of its course is fixed closely to the back wall of the abdomen. Elsewhere it is, like the small intestine, attached to it by a mesentery. No digestion takes place in the large intestine; but water is absorbed from it, and in travelling through it the contents become more solid and acquire their characteristic smell. They are now called *fæces* and are retained in the rectum until expelled (*defæcation*).

64. The fæces.—The anus is kept closed by a ring (sphincter) of muscles until the person wants to defæcate. The fæces or stools are the undigested remains of food, mixed with the useless remains of the digesting fluids and certain other substances. The whole mass is coloured by the bile, and contains bacteria or germs in very large numbers.

CHAPTER 8

EXCRETION

65. The bowels, as just stated, cast out (*excrete*) some of the waste-products of the body in the fæces. We have also seen that carbon dioxide is removed from the blood as it flows through the lungs. But, in order to keep alive, it is also essential to get rid of other impurities and waste which might accumulate in the blood, and this is done chiefly by the *kidneys* and *skin*.

The kidneys excrete *urine*, while the skin continuously

passes off *sweat.* Both these fluids consist of water in which waste-products from the blood are dissolved.

66. The kidneys.—The two kidneys are situated in the abdominal cavity, one on each side of the spinal column. They lie behind all the other contents of the abdomen, and their upper borders are as high as the 11th rib. Each has an artery passing into it and a vein passing out (Fig. 23). These blood-vessels are very large and the blood passes through them rapidly.

From each kidney a tube called the *ureter* runs down to the *urinary bladder*, in which the urine collects.

The kidneys may be regarded as filters through which all the blood of the body passes. They extract from the blood a substance called urea, together with other impurities. The cleansed blood flows out of the kidneys into the veins, while the urine containing the impurities drains into the ureters and so into the bladder.

The average amount of urine excreted in a day is about 50 oz., or 2½ pints, containing about 2½ oz. of solid matter. In cold weather the urine is more watery and abundant because less water is lost by sweating. If for any reason the kidneys cease to work, the blood soon becomes so full of waste-products that the person may die. This condition in which waste is not removed by the kidneys is called *uræmia* (literally, urea in the blood) and is one of the causes of unconsciousness and convulsions.

67. The bladder.—The urinary bladder lies in the pelvic cavity. It is a bag which is fixed at its base and free to expand upwards. It lies below all the intestines and rises into the abdomen only when very full. It will hold, none too comfortably, about one pint. At its lower part it opens into the *urethra*, through which the urine is voided (*micturition*) when convenient or when the bladder is full. As soon as the sphincter, or muscular ring, between the bladder and urethra is relaxed, urine is forced through it by the muscles of the bladder wall, aided by voluntary contraction of the abdominal muscles which increase the pressure.

When a patient is unable to pass water he is said to have *retention* of urine. This condition has many different causes, including in older men enlargement of the *prostate gland.* It may have to be relieved by introducing a special tube (*catheter*) into the orifice of the urethra and passing it along until it reaches the bladder and permits the urine to escape. In doing this, great care has to be taken to prevent introduction of germs with the tube.

68. The urethra.—In the male the urethra is the outlet not only for urine but also for reproductive fluid from the *testicles,* which contains the spermatozoa. As will be seen

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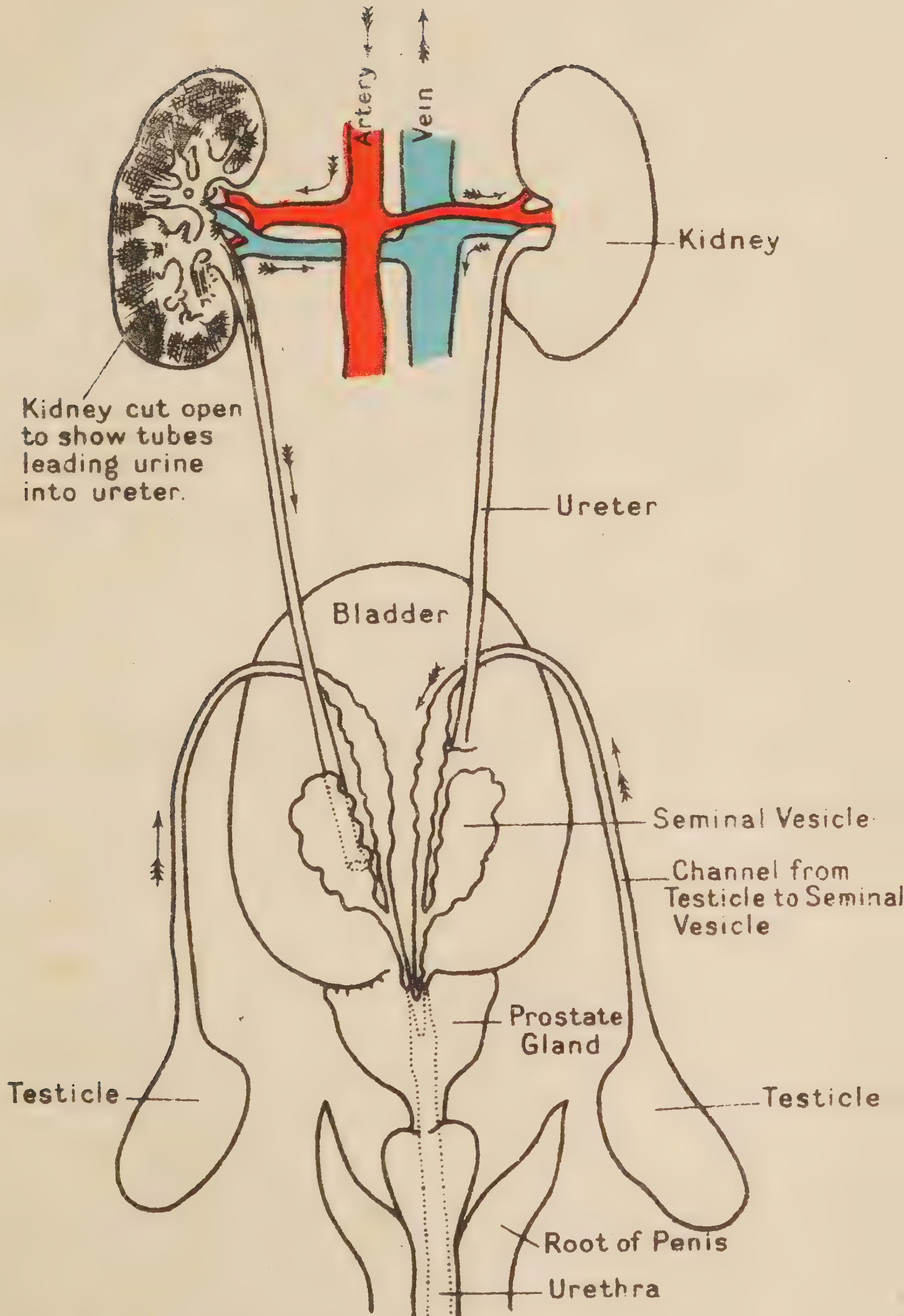

FIG. 23. THE KIDNEYS, BLADDER AND URETHRA.

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from Fig. 23, the channel from the testicle on each side joins the urethra just outside the bladder, where the urethra goes through the prostate gland. Fluid from the testicles, when mixed with the contents of the prostate and *seminal vesicles*, forms the *semen* (Latin, seed).

On the average the length of the urethra from the bladder to its orifice is $8\frac{1}{2}$ in. It passes out from the bladder through the prostate in a downward direction and then curves forward

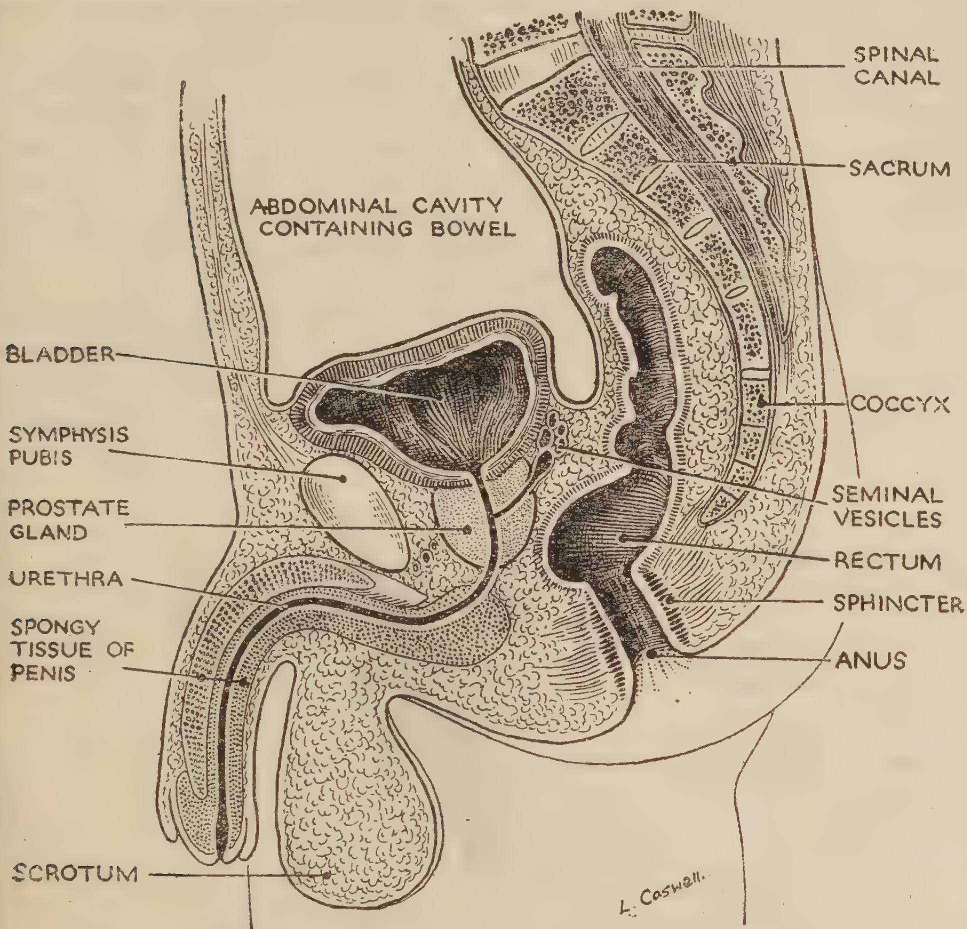

FIG. 24.—VERTICAL SECTION THROUGH THE BODY, SHOWING THE BLADDER, THE PROSTATE GLAND, THE URETHRA AND PART OF THE RECTUM.

under the junction of the two innominate bones (*symphysis pubis*). The rectum lies behind it as it goes through the prostate. In passing a catheter into the bladder, or the nozzle of an enema syringe into the rectum, it is important to know the positions of the various parts. Fig. 24 shows them in vertical section.

The part of the male urethra situated outside the body is called the *penis*. In this part of its course the urethral tube

is surrounded by loose spongy tissue which is well supplied with blood-vessels. Normally, and during the passage of urine, the penis is flaccid ; but during sexual excitement the empty spaces in the spongy tissue fill with blood so that it becomes erect and tense.

69. The skin.—The skin is the protective covering of the body. It has two layers (Fig. 25) :—

(*a*) The *epidermis* or cuticle is the thin semi-transparent outside layer. Its surface is waterproof and is composed of flattened cells, which are constantly being worn away and replaced by fresh cells from below. It contains neither blood-vessels or nerves. If observed under a magnifying glass it shows the mouths of sweat glands—the so-called pores. There are also *sebaceous glands*, producing an oily fluid which lubricates the hairs.

(*b*) The *dermis* or true skin consists of fibrous and elastic tissue and is freely supplied with nerves and blood-vessels. It contains the sweat glands, which excrete sweat, consisting of water and impurities from the blood.

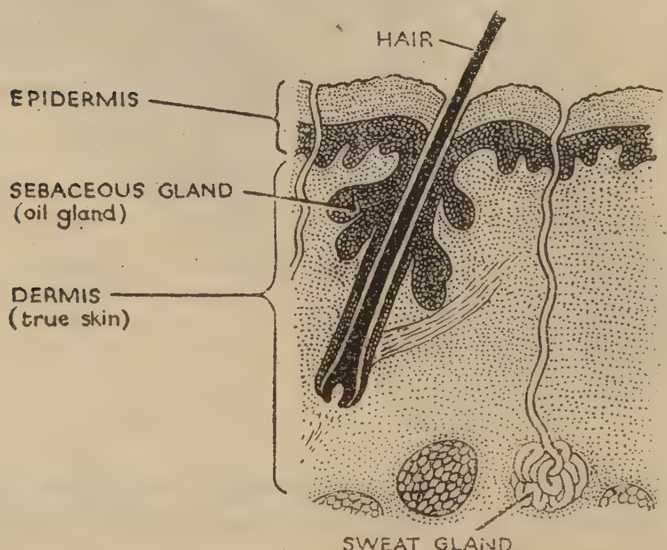

FIG. 25.—SECTION THROUGH SKIN, SHOWING A HAIR, A SWEAT GLAND AND A SEBACEOUS GLAND.

Evaporation of sweat is one of the means of preventin over-heating of the body : indeed in hot climates it is the mai method of keeping the temperature normal. As much as gallon of sweat may evaporate from the body daily. Th produces thirst—Nature's demand for more water—and al much reduces the amount of water excreted in the urine.

CHAPTER 9

CONTENTS OF THE CHEST AND ABDOMEN

70. Before going further, it may be useful to consider how the various organs already mentioned are fitted into the chest and abdomen. Figs. 26 and 27 give a good idea of the positions they occupy, but one must remember that in living bodies the heart alters its shape at every beat, the lungs expand and contract with every breath, the stomach may be distended or may sag, the intestines are always moving, and the bladder is sometimes full and sometimes empty.

The diagrams show the principal contents of (*a*) the chest or *thoracic cavity*, and (*b*) the belly or *abdominal cavity*. The boundary between these is a large dome-shaped muscle, the diaphragm. This has openings for the passage of the alimentary canal and the two main blood-vessels (aorta and inferior vena cava).

71. The thorax or chest is a cone-shaped cavity, with the diaphragm as its base. The walls have a bony framework: behind is the spine, and in front is the sternum or breast-bone, shown white in Fig. 26. These are connected by the ribs, which join the sternum through the costal cartilages, as was seen in Fig. 9, page 21. The spaces between the ribs are filled in by fibrous tissue and muscles, and these muscles help to expand the chest in respiration.

The contents of the thorax include :—

The heart and great blood-vessels.
Part of the trachea or windpipe.
The lungs.
Part of the œsophagus or gullet.

The trachea and œsophagus, and also the veins of the head, run down into the chest from the neck. The main arteries supplying the head run up into the neck from the chest.

The heart, as already explained, lies partly behind the sternum and partly behind the costal cartilages on the left side. Its apex-beat can be felt, and often seen, between the costal cartilages—usually between the fifth and sixth—about 3½ inches from the middle line of the body. The position of the second costal cartilage can be ascertained by feeling for a ridge running across the sternum ; this is faintly marked in

Fig. 26. The third, fourth, fifth and sixth can then be easily recognized.

It will be noticed that the lower border of the lungs is lower behind (Fig. 27) than in front (Fig. 26). The walls of the chest get additional strength from large muscles running between the spinal column, the scapula, the clavicle and the arm. The size of the chest cavity is greater during inspiration (when the ribs move outwards and the diaphragm becomes flatter) than in expiration (when the ribs fall in and the diaphragm is arched upwards).

72. The abdomen is roofed by the diaphragm. It is partly enclosed by the spinal column and the ribs, but elsewhere its walls are of muscle. Its floor is the pelvis, formed by the sacrum and the innominate bones, and its lowest part, containing the bladder and rectum, is called the *pelvic cavity*. Figs. 26 and 27 shows the approximate situation of the following important organs :—

Name of Organ	*Position*
Liver (red) and *gall-bladder* (blue).	On the right below the diaphragm and chiefly under the ribs.
Kidneys (purple) ...	Deep in the loins at the back of the abdomen. One on each side of the spine, reaching as high as the level of the 11th rib.
Bladder (blue) ...	Low down in the middle of the front of the pelvis.
Spleen (red)	On the left side under the ribs behind the stomach, close to the diaphragm.
Stomach (yellow) ...	On the left side, partly under the ribs; varying in size according as it is full or empty.
Bowels (yellow) ...	Filling the rest of the cavity and divided into the small intestine and the large intestine (ascending, transverse, descending, and sigmoid colon, and rectum).

The *pancreas* is not shown, since it is hidden by other organs. It lies in the centre, across the spine, a little above the level of the navel (umbilicus).

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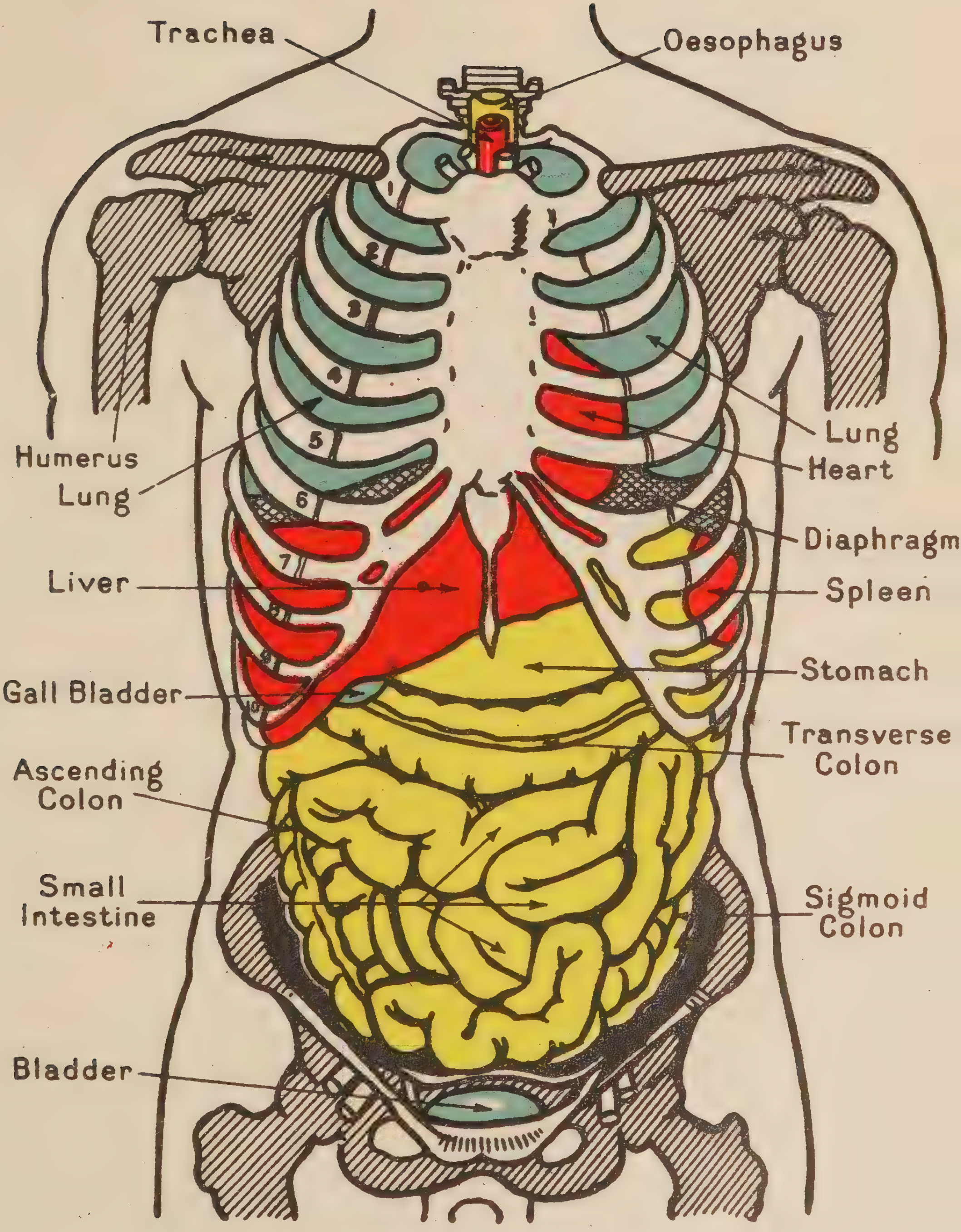

FIG. 26. CONTENTS OF CHEST AND ABDOMEN, SEEN FROM THE FRONT.

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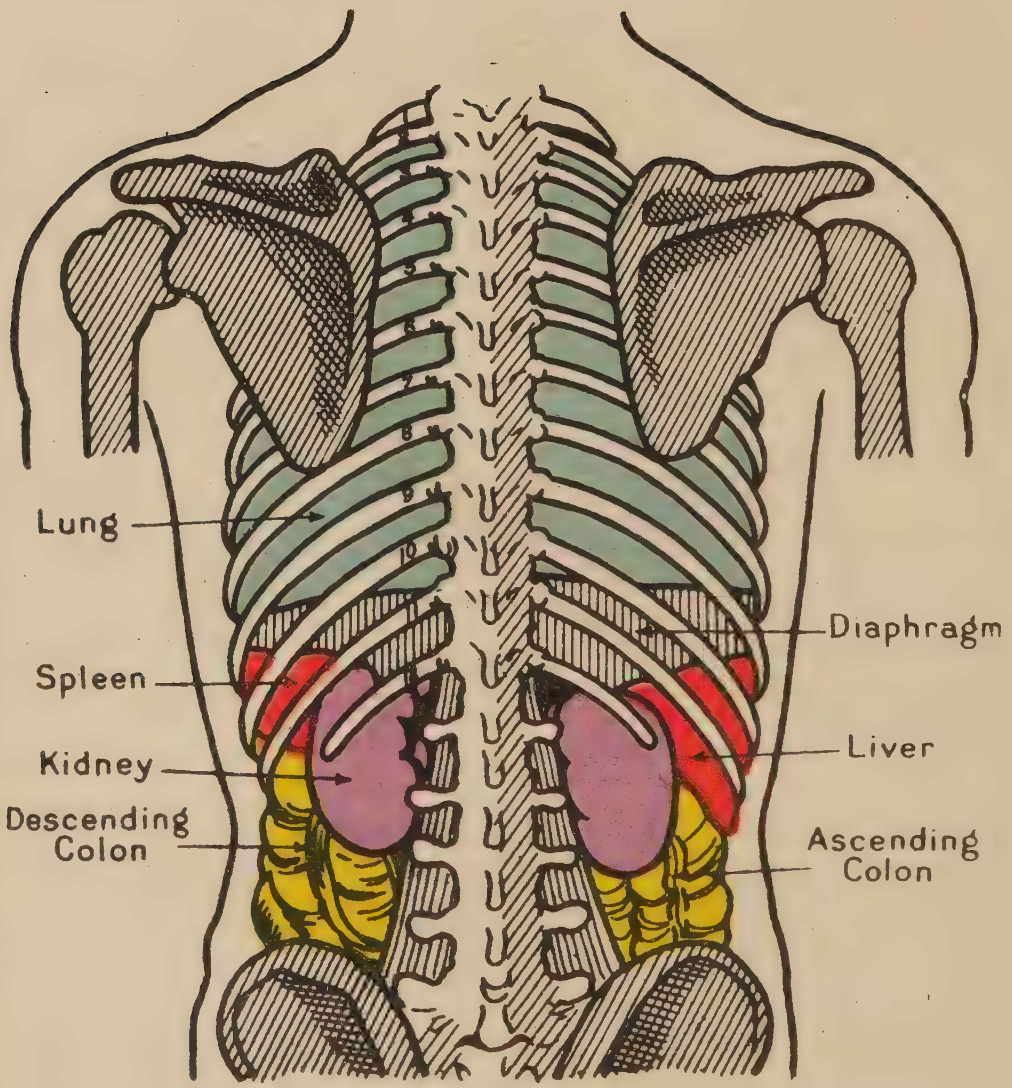

FIG. 27. CONTENTS OF CHEST AND ABDOMEN, SEEN FROM BEHIND.

CHAPTER 10

THE NERVOUS SYSTEM

73. The nervous system controls all the movements of the body. It consists of (*a*) nerve centres, (*b*) nerve cords, and (*c*) nerve-endings.

The nervous system has two parts :—

The *cerebrospinal* (or central) nervous system, controlling voluntary movements—*e.g.* of limbs.

The *autonomic* (or sympathetic) nervous system, controlling involuntary movements—*e.g.* of heart and intestines.

The cerebrospinal system comprises brain, spinal cord and nerves, while the autonomic system works through small nerve centres called *ganglia*.

74. The brain.—The brain is the great nerve centre of the body, and is contained in and protected by the skull. It is enclosed in three distinct membranes or skins : an outer known as the dura mater ; a middle called the arachnoid ; and an inner called the pia mater. These membranes continue downwards over the spinal cord. Between the inner membrane, which covers the brain and cord, and the middle or arachnoid membrane, is a space containing the *cerebrospinal fluid* (Fig. 28). This colourless fluid bathes and protects the brain and cord and also fills the cavities (*ventricles*) inside the brain. It is continually changed, being formed in the ventricles and absorbed by large veins in the membrane lining the skull.

The brain receives messages from nerve-endings, or outposts, in the eyes, ears, nose, skin, muscles, etc., and issues orders to the muscles to make them move in any desired way. It consists of countless nerve cells and nerve fibres.

The chief parts of the brain are the cerebrum, the cerebellum, and the brain-stem (Fig. 28).

The *cerebrum* lies uppermost in the skull and consists of two halves which look alike. The outer surface of the brain is covered with rounded ridges and furrows, and is plentifully supplied with blood-vessels which run into these furrows ; but the main blood-supply of the brain passes into its base.

Springing from the base of the brain are nerve cords, including the nerves of smell, sight, hearing and taste, and those causing movements of the eyes, tongue, jaw and face.

The *cerebellum* lies below the cerebrum. Like the cerebrum, it is divided into two parts, but it is much smaller.

The *brain-stem* (including the mid-brain, pons and medulla) is a mass of brain substance connecting the brain with the spinal cord.

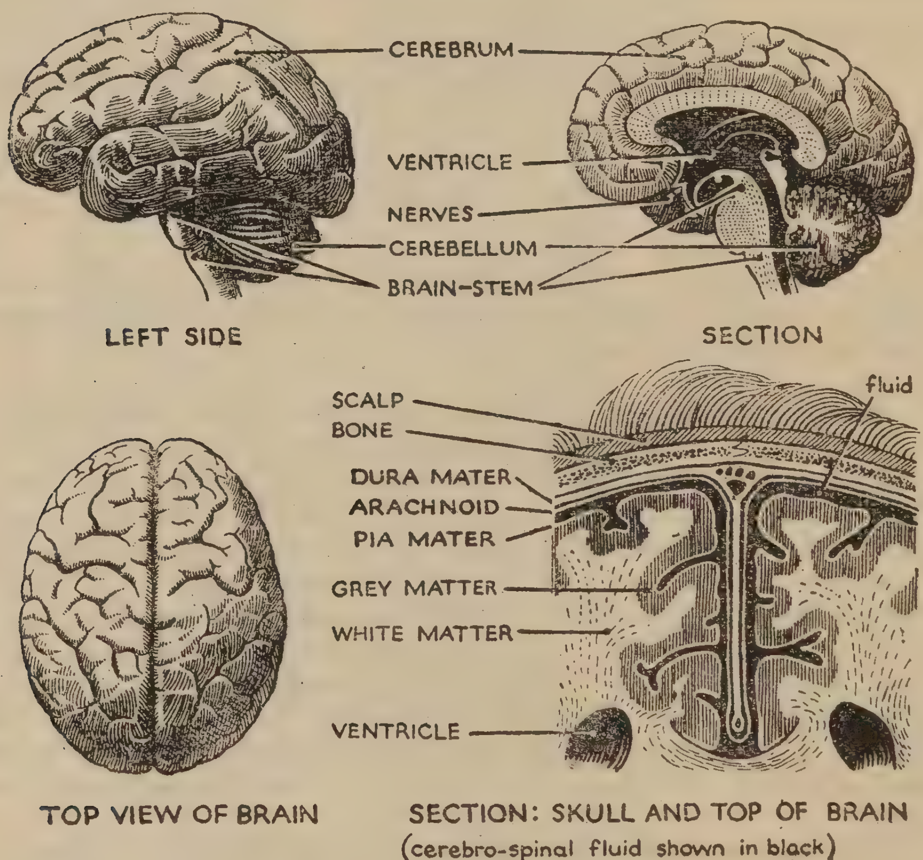

FIG. 28.—THE BRAIN.

75. The spinal cord.—This is a long cylinder of nerve matter running down from the brain into the spinal canal within the spinal column. It goes as far as the first lumbar vertebra, and is about 18 inches long. At each interval between vertebræ a pair of nerve cords can be seen leaving or joining the cord, one on each side (Figs. 29). Each consists of (*a*) a motor nerve trunk carrying orders to muscles, and (*b*) a sensory nerve trunk carrying messages to the brain (Fig. 30).

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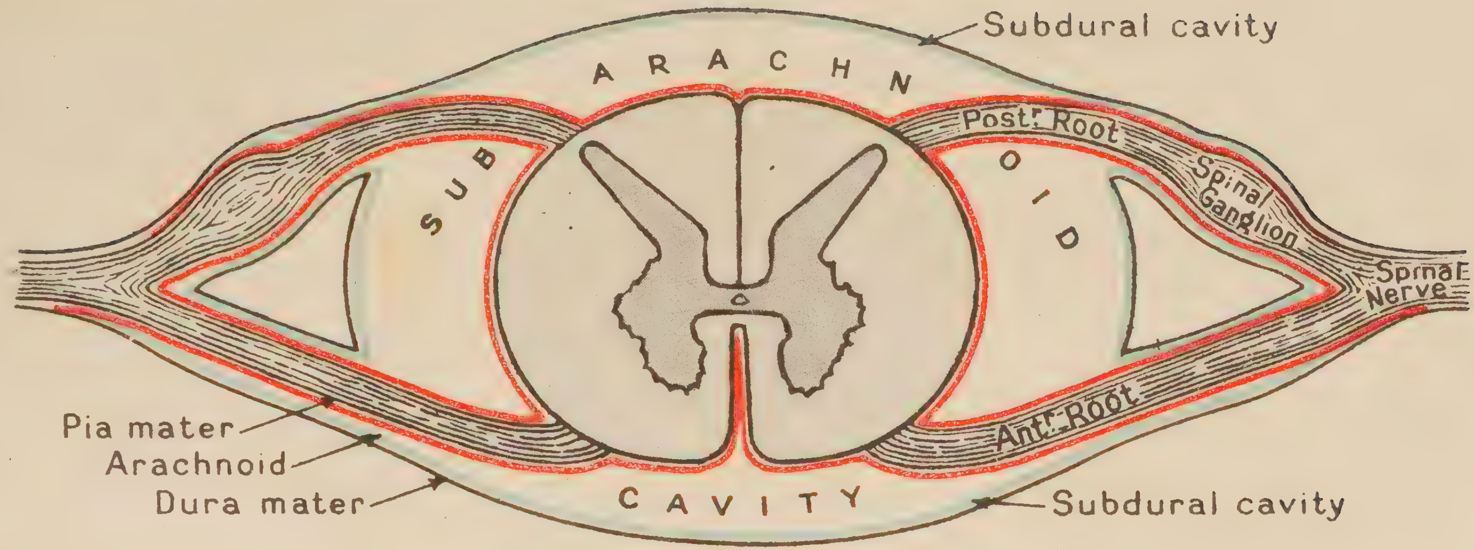

FIG. 30. CROSS SECTION THROUGH, THE SPINAL CORD.

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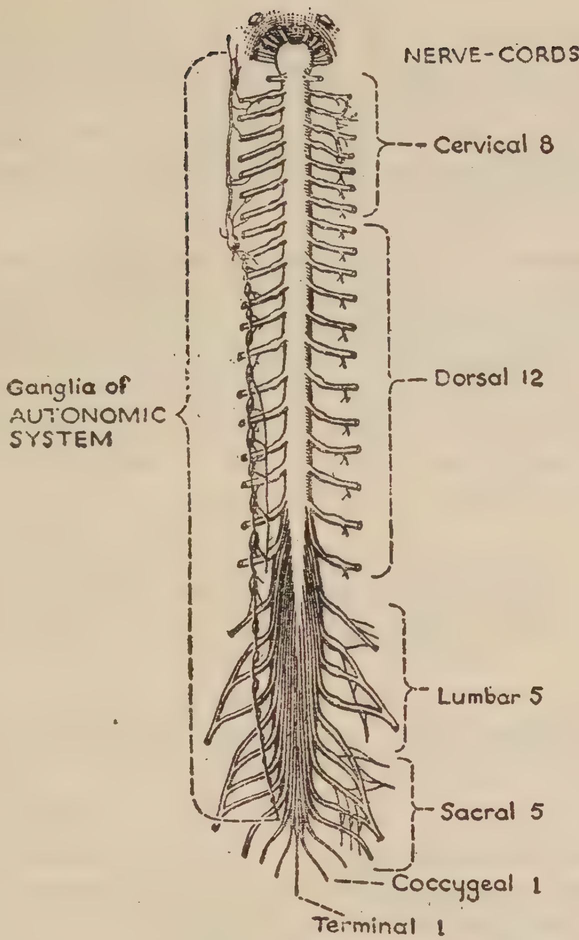


FIG. 29.—THE SPINAL CORD.

76. Nerves.—Nerve cords and nerves are the connecting threads between the nerve centres and nerve endings. They are, therefore, attached at one end to the brain or spinal cord and at the other terminate in the nerve-endings, whether in the skin, in organs of sense such as the eyes and ears, or in the muscles. In the motor nerves the messages run outwards from the brain or spinal cord, carrying orders to muscles. In the sensory nerves they run inwards to the brain or spinal cord, carrying the impressions made by light, colour, noise, heat, cold, touch and other stimuli. *Motor* means " moving " ; *sensory* means " feeling."

77. Nerve-endings.—These are found in every part of the body. The nerve-endings of sensory nerves send to the spinal cord and brain information of what is taking place at the point where they are situated. For instance, with the end of the finger we can tell whether anything we touch is rough or smooth, hot or cold. Other nerve-endings in the ear, eye,

tongue or nose send to the brain information about sounds, sights, tastes and smells. Acting on this information, the brain can send an order by motor impulse to any muscle or set of muscles, by the nerves which pass into them, and so make the desired movement. Messages can be sent not only to muscles but also to glands like the salivary or sweat glands.

78. Functions of the cerebrospinal system.—The *cerebrum* is the seat of thought, will, sensation and emotions. It is possible for life to continue for a time without this higher brain: thus breathing and swallowing may go on after consciousness has been lost (*e.g.* in concussion of the brain).

The main function of the *cerebellum* is to co-ordinate the action of various muscle groups which work together in any complicated combination of movements, such as walking or running.

The lower part of the *brain-stem* contains the centres which regulate the heart, respiration and swallowing. Any injury seriously interfering with these vital nerve centres is likely to be fatal.

The *spinal cord* is the channel by which motor and sensory impulses or messages are carried to and from the brain; it also contains centres for reflex actions.

79. Reflex actions.—The mechanism of reflex action has been briefly explained in para. 8. Many messages reaching the spinal cord through sensory nerves are not sent up to the brain, but pass directly across to the motor nerve which conveys the message down to a muscle: thus the stimulus to a particular sensory nerve-ending is followed automatically by a particular action. Where, on the other hand, automatic (reflex) action is insufficient, and intelligent (voluntary) action is required, the message travels up to the brain, consciousness is awakened, and any necessary order is then sent down to the appropriate set of muscles.

The great difference between voluntary and reflex action is that in the one case the person is conscious of the desire to make the movement, and can make it at will, whereas in the other case the action takes place spontaneously

80. The autonomic nervous system.—This consists of a chain of nerve ganglia (literally, knots) mostly lying at the side of the spinal column and intimately connected with the spinal nerves. This system controls those functions of the body that may be considered automatic, such as the contraction and dilatation of the blood-vessels and movements of the intestine. It is controlled by the brain and influenced by the emotions, but not by the will.

81. Effects of injury.—Injury to nerves causes loss of power or sensation in the parts which they supply. The nourishment of the paralysed part also suffers. Pressure sores are especially likely to appear within an area of sensory loss.

The spinal cord is composed of large nerve cells, and nerve fibres connecting the brain with the trunk and limbs. When it is torn through or badly crushed, the result is paralysis of both sides of the body below the point of injury, and loss of sensation, with paralysis of bladder and bowel. The spinal cord if divided does not recover.

When a nerve is completely severed, it may be repaired, but this takes a long time, and sensation and motor power return very slowly.

CHAPTER 11

THE EYE

82. The eye is shaped like a globe, as shown in Fig. 31, and is set in a bony socket called the *orbit*. It is partly covered by the eyelids for protection ; so only a small portion is visible.

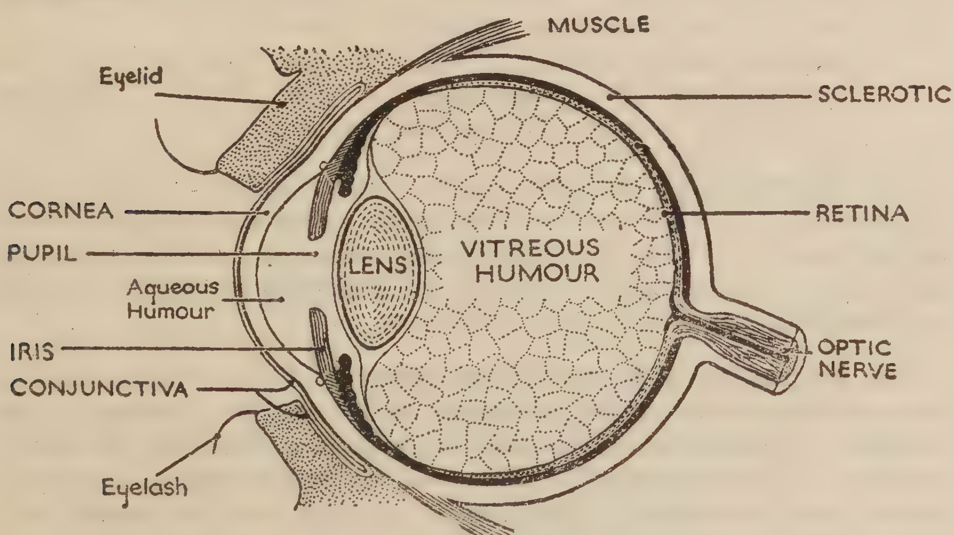


FIG. 31.—THE EYE.

The visible portion of the eye is covered by a thin transparent membrane or skin, the *conjunctiva,* which also covers the inner surface of the eyelids. When this membrane becomes inflamed, the blood-vessels in it dilate and the eye looks red.

The tear glands continuously secrete a watery fluid which protects the conjunctiva by keeping it moist. When the eye is injured or infected—and sometimes for other reasons—the tears run faster.

83. Structure of the eye.—The most important parts of the eye are :—

The *cornea*, the circular clear window of the eye in front.

The *iris*, the coloured part of the eye. It is a diaphragm or partition with a round hole in the centre, called the *pupil*, which appears black. The colour of eyes depends on the amount of pigment (black colouring matter) in the iris. Brown eyes have more pigment than grey or blue eyes.

The *lens*, placed just behind the iris ; about the size of a pea and shaped like a magnifying glass.

The *vitreous*, a clear jelly which fills the main cavity of the eye, and serves to maintain its shape.

The *retina*, a sensitive screen, which covers the inner surface of the eyeball. It contains nerve-endings, and nerve fibres leading to the *optic* nerve, or nerve of sight.

The *sclerotic*, continuous with the cornea in front ; a tough outer coat, covering the whole eyeball.

The *optic nerve*, from the back of each eye, carrying the nerve fibres from the retina to the brain. It passes through a hole at the back of the orbit.

84. Movements of the eyes.—The eyeball moves in a layer of fat in the orbit ; and by means of six muscles, attached at various points to the sclerotic of each eye, the eyes can be moved in any direction. Squint is caused by a loss of balance between the muscles of the two eyes.

85. Function of the various parts.—The cornea and lens reduce the size of an object seen, and focus the image on the retina. The lens is elastic and is capable of altering its shape rapidly so that objects at different distances can be focussed clearly on the retina. The change of focus from a distant to a near object is called *accommodation*.

The iris acts like the diaphragm of a camera. It contracts or expands to alter the size of the pupil and thus regulates the amount of light entering the eye. The pupil is small in bright light, and large in dim light. A small pupil prevents dazzle from too much light.

The retina is the sensitive part of the eye, corresponding to the film of a camera. Light falling on the retina stimulates

the nerve-endings of the optic nerve, and thus produces impulses which the nerve conveys to the brain. By analysing the impulses received through the optic nerve, the brain can appreciate the shape, colour, size and position of objects within the range of vision.

The fact that each eye sees the object from a slightly different angle gives stereoscopic vision, which makes judgment of distance much easier.

86. Defective vision.—In short sight the eye is abnormally long from front to back. Consequently the image of distant objects, instead of being focussed on the retina, is focussed a little in front of it, and being out of focus is blurred.

In long sight the eye is abnormally short and the image of near objects is focussed behind the retina, making them blurred.

These and other errors are corrected by means of spectacles which focus the image on the retina.

In later life spectacles are almost always required for near vision, because, as age advances, the lens becomes less elastic and accommodation is therefore more difficult.

CHAPTER 12

THE EAR

87. For purposes of description, the organ of hearing is divided into three parts—the external ear, the middle ear and the internal ear. The function of the external ear and middle ear is to transmit sound waves to the internal ear, which analyses them and reports its findings to the brain.

88. The external ear.—The visible projecting ear is merely an external flap, made of cartilage covered with skin, which guards the ear-hole. From this hole the *external auditory canal* leads to the *ear-drum.* The " external " ear includes not only the external flap, but also the external auditory canal—*i.e.* the whole ear as far as the drum (Fig. 32).

The canal, from ear-hole to drum, is about $1\frac{1}{4}$ inches long, and is slightly curved. The skin lining its outer half is hairy and contains wax-producing glands; the hairs and wax hinder insects and other small " foreign bodies " from reaching the delicate drum. The inner half is a bony tunnel lined with thinner skin. It ends blindly at the ear-drum (Fig. 32), a thin parchment-like membrane which vibrates with every sound.

89. Middle ear.—On the inner side of the ear-drum is the middle ear, a small cavity hollowed out of the temporal bone. The vibrations of the drum are conveyed across the middle ear by three very small interlocking bones (*ossicles*) arranged in such a way that they magnify (amplify) the sound waves.

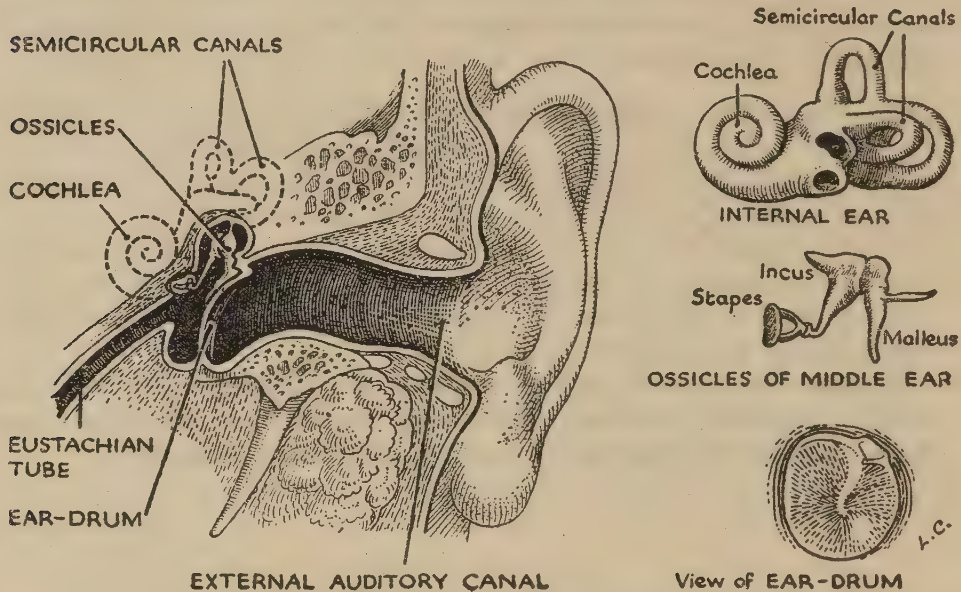


FIG. 32.—THE EAR.

From the middle ear a narrow canal (the *Eustachian tube*) runs to the back of the throat. This canal admits air from the throat to the middle ear, thus balancing the atmospheric pressure on the two sides of the drum and allowing it to move freely. If for any reason, such as a cold in the head, one or both Eustachian tubes are obstructed, partial temporary deafness is the result. The explanation is that when air is imprisoned in the middle ear its oxygen is absorbed and its volume and pressure therefore fall. The drum is then pushed inwards by the greater atmospheric pressure on its outer side, and when it receives sound waves it no longer vibrates in the ordinary way.

Besides admitting air, the Eustachian tubes may also admit infection to the middle ear. Germs may thus find their way to the ear :—

(*a*) From tonsils and adenoids, especially in children.
(*b*) From one of the numerous cavities (*sinuses*) connected with the nose, which are sometimes infected.
(*c*) From infected teeth and gums.

Infection in the middle ear (*otitis media*) may give rise to an abscess which bursts through the drum. Pain is usually

relieved as soon as the drum is perforated and matter escapes ; but sometimes the hole in the drum does not heal and the patient may afterwards have a discharging or running ear for months or years. To prevent this permanent damage to the drum, the surgeon may himself make a small opening in it to let the pus escape.

There is also a communication between the middle ear and certain small cavities in an adjoining bone (the *mastoid* process of the temporal bone). The mastoid process forms the hard bony lump behind the external flap of the ear, and when infection reaches the cavities inside it an abscess sometimes forms which may have to be opened by operation.

Boils in the external auditory canal often cause severe pain, which may be mistakenly attributed to mastoid infection.

90. The internal ear.—This comprises (*a*) the cochlea, which is the essential organ of hearing, and (*b*) the vestibular apparatus, which regulates balance.

Cochlea is the Latin for "shell," and the cochlea is coiled like a snail shell (Fig. 32). The vibrations of sound, conducted across the middle ear by the chain of ossicles attached to the drum, reach the cochlea through a small window on the inner wall of the middle ear. The *auditory nerve*, or nerve of hearing, has its nerve-endings in the cochlea. Each particular sound has a particular wave-length and is picked up by particular nerve-endings. On receiving a message from these nerve-endings, the brain is aware of that particular sound.

The *vestibular apparatus* consists of three *semicircular canals*, filled with fluid. When the position of the head is changed, this fluid presses on a different part of the walls of these canals and so stimulates a different set of nerve-endings. The brain is thus informed about the change of position.

91. Functions of the various parts.—The external ear merely collects and carries vibrations (sound waves) to the drum of the ear. The vibrations of the drum are conducted across the middle ear by the chain of ossicles, and are thence transmitted to the fluid in the internal ear. A very delicate mechanism inside the cochlea contains strands which, like the wires of a piano, respond only to one particular note or vibration. As each sound wave passes through the fluid it activates the corresponding strand or strands ; these stimulate the appropriate nerve-endings, which then report to the brain through the auditory nerve.

The impressions conveyed to the brain from the semicircular canals indicate the position and movements of the head, which are intimately connected with balance. Excessive and unaccustomed movements—as on board ship or in an aircraft—produce confusing impressions and cause sea or air sickness.

CHAPTER 13

THE NOSE, MOUTH AND THROAT

92. The nasal passages.—The shape of the nose is maintained by a scaffolding of bone and cartilage. The cartilaginous portion is the resilient tip of the nose, which can withstand considerable knocks without damage. The floor is formed by the upper surface of the *hard palate* and the *soft palate*, which roof the mouth (Fig. 33).

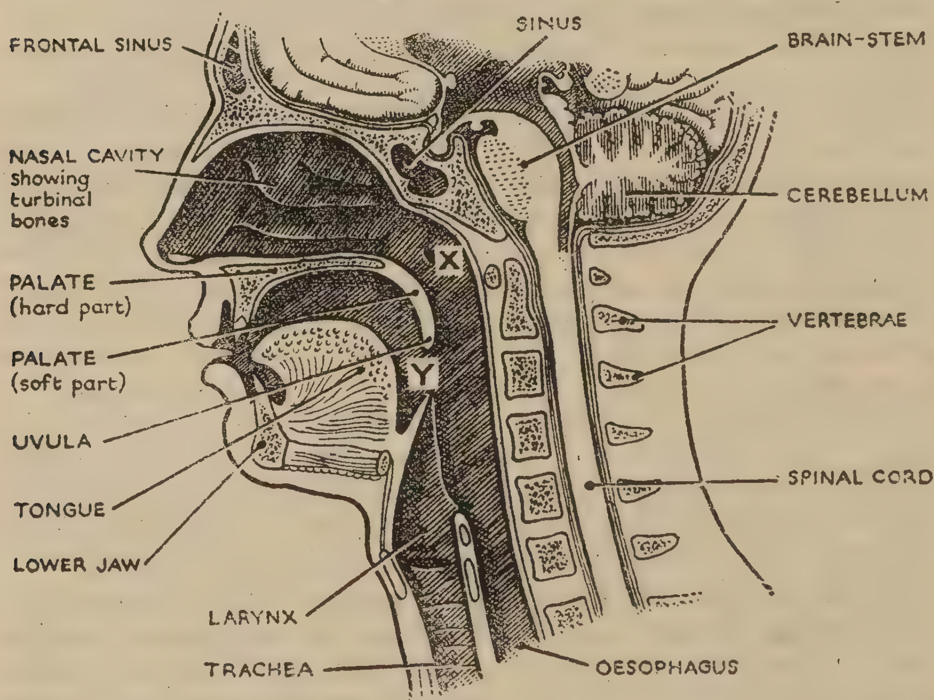


FIG. 33.—CROSS-SECTION THROUGH THE HEAD AND NECK TO SHOW THE CAVITIES OF THE NOSE, MOUTH AND THROAT. X=POSITION OF ADENOIDS. Y=POSITION OF TONSILS.

The partition between the two sides is formed of cartilage in front and bone behind, and is called the *septum*. This structure is often damaged by blows, as in boxing, and may become twisted or bent in such a way that the airway on one or both sides is obstructed. Such obstruction can be readily relieved by an operation.

Curved *turbinal bones* project into the nose from its outer walls, and almost divide the airway on each side into three separate channels (Fig. 34).

In the bones of the face surrounding the nose there are air-filled cavities, called *nasal sinuses*, which communicate with the nasal channels. From the inner angle of the eye a tear-duct runs down to open under the lowest turbinal bone.

Just inside the nostrils, which look downwards, the nasal cavity is lined with hairs which intercept some of the larger particles of dust and stop them from entering the air-passages. Beyond this the lining of the nasal passages consists of a moist mucous membrane with a good blood-supply; and in

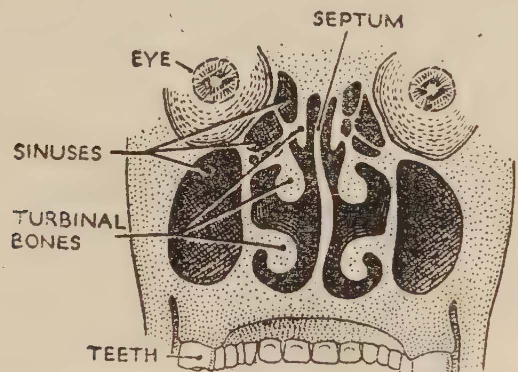


FIG. 34.—CROSS-SECTION THROUGH THE FRONT OF THE FACE TO SHOW HOW THE NASAL CAVITY IS DIVIDED BY THE TURBINAL BONES.

Air-containing cavities (sinuses) in neighbouring bones are also seen. These sometimes become infected.

passing through the narrow channels between the turbinal bones the air is warmed, moistened and purified on its way to the lungs.

> Bleeding from the nose (epistaxis) is caused by the rupture of one or more blood-vessels in the mucous membrane. The usual place for the rupture is the front part of the septum where the thin-walled vessels are very near the surface. Bleeding from this area can be controlled by sitting the patient up and firmly pinching the cartilaginous end of the nose.

The nerves that serve the sense of smell enter the nose through the roof and descend a short distance in the mucous membrane covering the septum and outer wall. When a person catches cold the mucous membrane lining the nasal passages is inflamed, and the sense of smell is lost if the

swelling of the membrane over the turbinal bones is sufficient to prevent air reaching the upper part of the nose.

At the back, the nose opens into the upper part of the throat, and it is here that collections of spongy tissue, called *adenoids*, often develop in young people (Fig. 33). They may make it impossible to breathe through the nose and may have to be removed.

93. The mouth.—The cavity of the mouth can easily be inspected and needs little description. Its roof, which separates it from the nose, is formed by the hard palate in front and the soft palate behind. From the back of the soft palate the *uvula* can be seen hanging downwards (Fig. 35).

The *tongue* is a muscular organ fixed at its base to a small curved bone which can be felt just above the prominence of

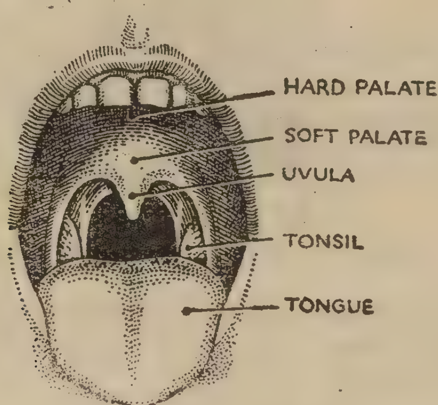


FIG. 35.—THE OPEN MOUTH.

Adam's apple (the *thyroid cartilage*) under the skin in front of the neck. The tongue is covered on top with a thick rough mucous membrane, which has in it the nerves of taste. Sweet, acid, salt and bitter are the tastes perceived by the tongue and palate ; all other so-called tastes are perceived in the nose by the nerves of smell. The tongue can move in most directions, and is especially active in speech, in the mastication of food, and in starting the act of swallowing.

Several *salivary glands*, producing saliva, are situated near, and open into, the mouth. They are the parotid glands, which lie below the ear beside the angle of the jaw on each side and are usually enlarged in mumps ; the sublingual glands under the tongue ; and the submaxillary glands inside the angle of the lower jaw. There are also many glands which pour out mucus and keep the mouth moist.

The *teeth* will be described in the next chapter.

94. The pharynx or throat.—The pharynx is the cavity at the back of the nose and mouth. It is the passage through which food goes down into the œsophagus and air goes down into the larynx.

Obviously it is important that food should not accidentally go through the larynx into the lungs. In the act of swallowing, therefore, the entrance of the larynx is automatically closed by contraction of the surrounding muscles. The mouthful of food is at the same time shot off the tongue, gripped by the muscles of the pharynx and œsophagus, and passed down into the stomach by a wave of muscular contraction.

95. The tonsils.—Figs. 33 and 35 show the position of the tonsils, one on each side at the back of the throat. They are really lymph glands, of which there are many in the neck and elsewhere; but they are peculiar in that they have no capsule or covering on their inner or throat surfaces. These exposed surfaces of the tonsils form a trap for germs, which they pick up and destroy; and the tonsils probably play a useful part in defending the body against infection. Unfortunately, however, they themselves often become heavily infected, and when the infection persists for a long time it may be found best to remove them. Germs from diseased tonsils sometimes find their way through the Eustachian tubes into the middle ear.

CHAPTER 14

THE TEETH

96. The teeth are hard bony structures consisting of three parts—the crown, the root and the neck. The *crown* is the enamel-covered portion of the tooth projecting above the gum; the *root* is the portion embedded in the jaw; and the *neck* is the narrower portion between the crown and the root. A central cavity contains the *tooth pulp*, which is a sensitive soft structure containing blood-vessels, lymph vessels and nerves, which enter the tooth through a small opening at the end of each root (Fig. 36).

97. Two sets of teeth.—The teeth appear in two sets, pushing their way through the gums by the process known as *eruption*:—

The *temporary or milk teeth*, 20 in number, begin to appear about the seventh month after birth. Usually they are all fully erupted by the end of 2½ or 3 years, and they are eventually replaced by permanent teeth.

The *permanent teeth*, 32 in number, comprise, from front to back in each half of each jaw :—

2 incisors (cutting teeth).
1 canine (prehensile teeth).
2 premolars (grinding teeth).
3 molars („ „).

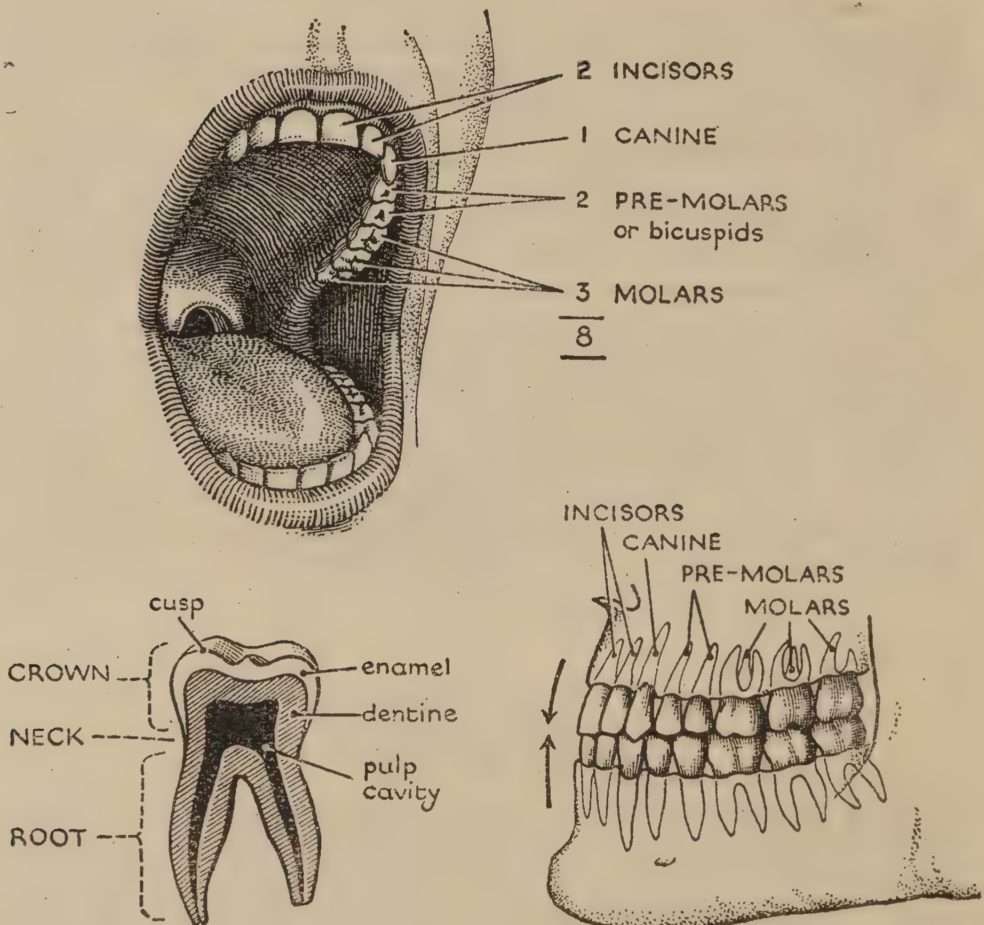


FIG. 36.—THE TEETH. THE BOTTOM RIGHT-HAND DRAWING SHOWS THE ROOTS PASSING INTO THE UPPER AND LOWER JAWS.

The arrows indicate the direction in which teeth should be brushed.

The canine or dog-tooth is pointed : it has only one point or *cusp* to its crown. The premolars have two cusps. Usually the molars in the upper jaw have four cusps, while those in the lower jaw have five. The upper molars as a rule have three roots and the lower molars two roots. The first upper premolars often have two roots and the rest of the teeth usually have single roots (Fig. 36).

The approximate order and dates of eruption of the permanent teeth are as follows :—

First molars and incisors, 6 to 8 years ; first premolars, upper second premolars and lower canines, 10 to 12 years ; lower second premolars, upper canines and second molars, 12 to 13 years ; third molars (wisdom teeth), 20 to 25 years.

98. Decay of teeth.—Dental caries, or decay of the teeth, is regrettably and unnecessarily common. It usually occurs in two stages :—

(*a*) When sweet or starchy food particles lodge between the teeth, or form a film over the surface, they begin to ferment and form an acid. In the course of months or years this acid eats holes in the hard layer of enamel covering the crown and then penetrates into the specialized bony part (*dentine*) which forms the great bulk of the tooth.

(*b*) The dentine is further destroyed by the action of certain germs or bacteria.

The ability of the teeth to resist decay depends partly on the diet in early life—and indeed on the mother's diet before the child is born. But once the teeth are erupted, the best means of preserving them is to keep them clean and thus prevent formation of acid on their surface. The regular use of a toothbrush is especially necessary for Western Europeans because their food largely consists of substances that need little biting and are often sweet and sticky.

99. The toothbrush.—Ideally the toothbrush should be used after every meal. What is most essential, however, is that the teeth should be carefully brushed *last thing at night*, and that no food (except possibly a raw apple) should be taken afterwards. If this is not done, the food particles always remaining on or around the teeth will ferment and form acid during the night, when they are not disturbed by the movements of the tongue, lips and cheeks.

Many people—perhaps the majority—still brush the front of their teeth from side to side. This is wrong : the movement should be downwards for the upper jaw and upwards for the lower jaw, so as not to push the gums away from the crowns of the teeth. The skilful tooth-brusher also pays as much attention to the back of the teeth as to their fronts. After brushing, the mouth should be rinsed with clean water.

The toothbrush, which ought not to be large, should be rinsed after use and hung up to dry.

100. Importance of dental hygiene.—Should a tooth or the gum become painful, or should a hole be discovered in a tooth, the dental officer should immediately be consulted.

A clean mouth is of great importance to the general health. Without good teeth, food cannot be properly masticated, and digestion is impaired. Further, an unclean mouth is an ideal breeding-ground for bacteria, the poisons from which are absorbed and sometimes cause serious disorders such as rheumatism.

Particular attention should be paid to the dental hygiene of patients in hospital, especially bed cases, and facilities should be provided to enable them to keep their mouths clean. It is also essential that all men dealing with the sick, and all men handling food, should take care to ensure that their own mouths are clean and healthy.

SECTION II.—BANDAGING

CHAPTER 15

BANDAGES AND KNOTS

101. Every wounded man has to be bandaged. So has every patient with a broken bone or a dislocated joint, a burn, a sprained ankle or a cut finger. The use of bandages is thus very widespread, and it is important to know how to apply them properly. This cannot be learnt from a book, but only by actual practice. In a class of learners it is a good plan to divide the party into two; each man can then practise bandaging his opposite number, who can afterwards practise on him.

It is worth while to become a really skilful bandager, because the comfort and sometimes even the life of a patient may depend on the correct application of a bandage. For instance, a bandage applied too loosely may fail to control severe bleeding, or applied too tightly may impede or stop the circulation in a limb.

102. Bandages.—A bandage is a piece of cloth or fabric, preferably both strong and soft. It is made of special material for special purposes, but it can be improvised from a strip of sheet or clothing, a handkerchief or a towel. It is used for the following purposes :—

To hold dressings in position.—Without a bandage a dressing may easily slip or fall off.

To fix splints.—The object of a splint is to keep a broken limb immovable ; therefore the splint must be securely fixed.

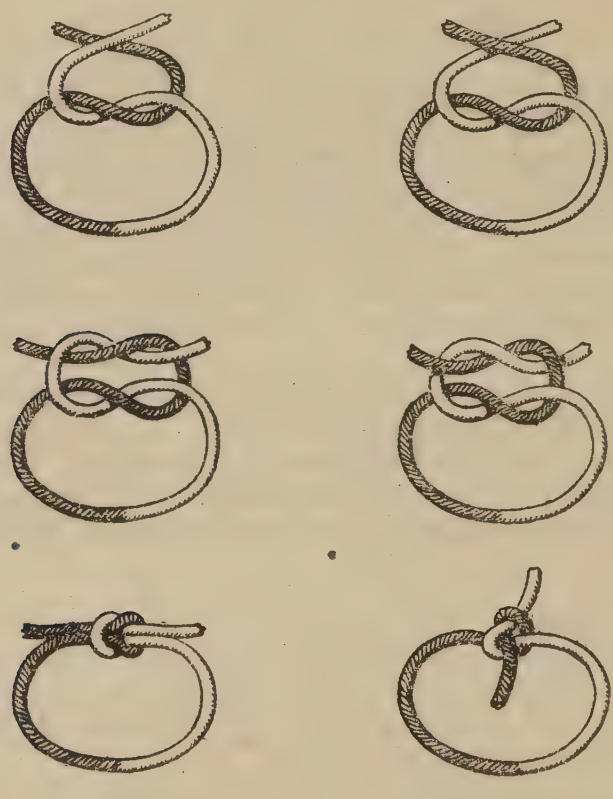
To control bleeding by pressure.—A tight bandage closes the small superficial blood-vessels, so that no blood escapes from them. It cannot stop the bleeding from large deep vessels, though it may diminish it.

To give support.—A bandage is helpful in supporting a sprained ankle, or (in the form of a sling) for a broken arm.

There are three main kinds of bandages—*triangular* bandages, *roller* bandages, and *special* bandages. These will be

described in detail later. It is first necessary to learn how to secure or tie them.

103. Fixing bandages.—There are two ways of securing the ends of bandages—by tying and by pinning. Tying is preferable, but not always possible.



REEF KNOT GRANNY KNOT

FIG. 37.—HOW TO TIE A REEF KNOT.

Tying.—The ends of the bandage should be secured by a reef knot, and not by an ordinary (granny) knot. A reef knot does not slip and is more easily undone. To make a reef knot, start as for an ordinary knot, but in the second part cross the loose ends in the opposite way, as shown in Fig. 37.

Pinning.—A safety-pin should be used. Keep one finger of the left hand, if possible, between the bandage and the patient's skin, to make sure that he is not pricked.

CHAPTER 16

THE TRIANGULAR BANDAGE

104. A triangular bandage is the half of a piece of calico or linen, 38 inches square, which has been cut diagonally into two. It has three borders. The longest is called the *lower border*, the two others the *side borders*. Of the three corners, the upper one (opposite the lower border) is called the *point*, and the others the *ends* (Fig. 38).

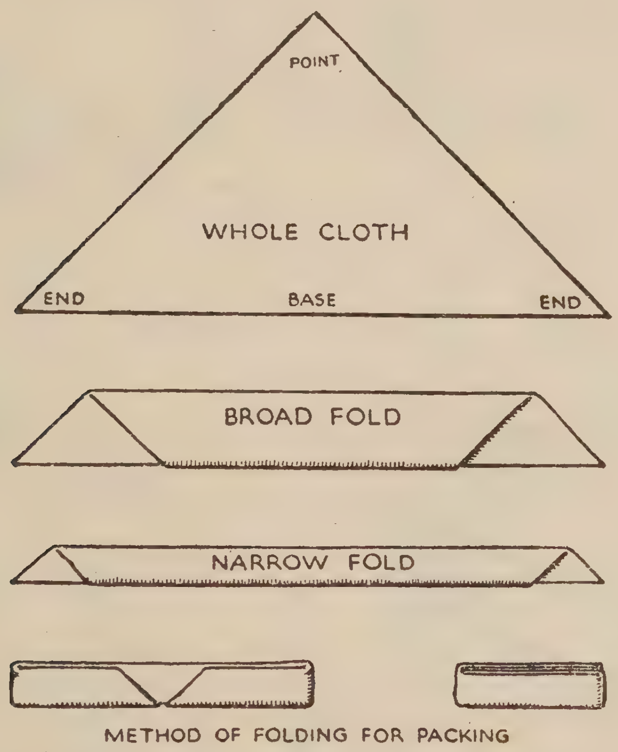


FIG. 38.—THE TRIANGULAR BANDAGE.

The bandage may be applied :—

As a *whole-cloth, i.e.* spread out to its full extent.

As a *broad-fold*, made from the whole-cloth by carrying the point to the centre of the lower border and then folding the bandage again in the same direction.

As a *narrow-fold*, made by folding the broad-fold once lengthways.

105. Slings.—Triangular bandages are used to make slings.

The greater arm-sling (Fig. 39).—Place the patient facing you with his arms to his sides. Apply a whole-cloth to his chest with the point towards the injured limb ; the upper end goes over the shoulder on the sound side and the lower end hangs down in front. Carry the upper end round the back of

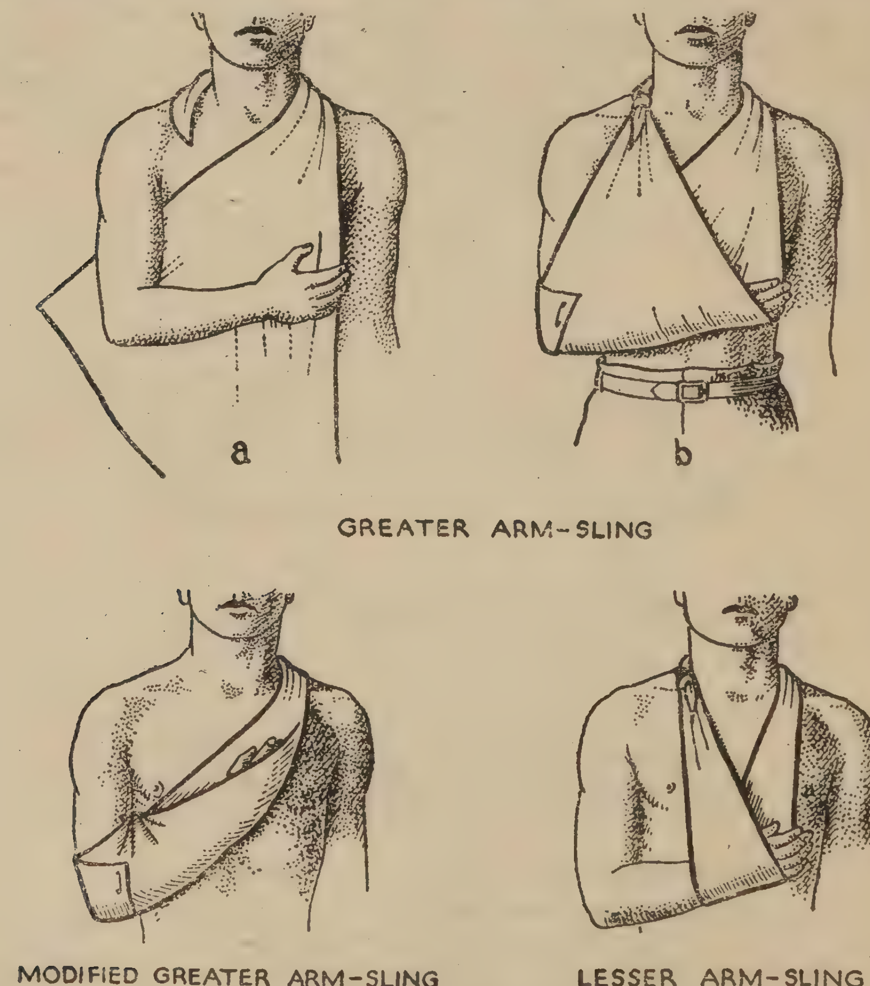


Fig. 39.—Slings.

the neck and then forwards over the opposite shoulder. Draw the point backwards between the chest and the injured arm so that it lies behind the elbow. Bend the injured arm carefully at the elbow, and bring the forearm across the chest so that it lies over the middle of the bandage, with the thumb upwards (Fig. 39a). Pick up the lower end, bring it upwards in front of the forearm, and knot it to the upper end, which is lying in front of the shoulder on the injured side. Draw

the point forwards round the arm and elbow and secure it with a pin (Fig. 39b).

Modified greater arm-sling (Fig. 39).—After the lower end has been brought up over the forearm it can be passed between the arm and chest and knotted at the back. This is sometimes done in cases of fracture of the clavicle, to avoid pressure on the broken bone.

The lesser arm-sling (Fig. 39).—Take a broad-fold and place one end of it over the shoulder on the sound side, letting the other end fall down in front. Carry the top end round the back of the neck so that it lies over the opposite shoulder. Bend the arm carefully, placing the wrist across the middle of the bandage, with the hand a little higher than the elbow. Bring up the lower end and knot it to the upper end, which is hanging over the shoulder on the injured side.

106. Application to special regions.—Triangular bandages may be used to keep dressings in place in various parts of the body (Fig. 40).

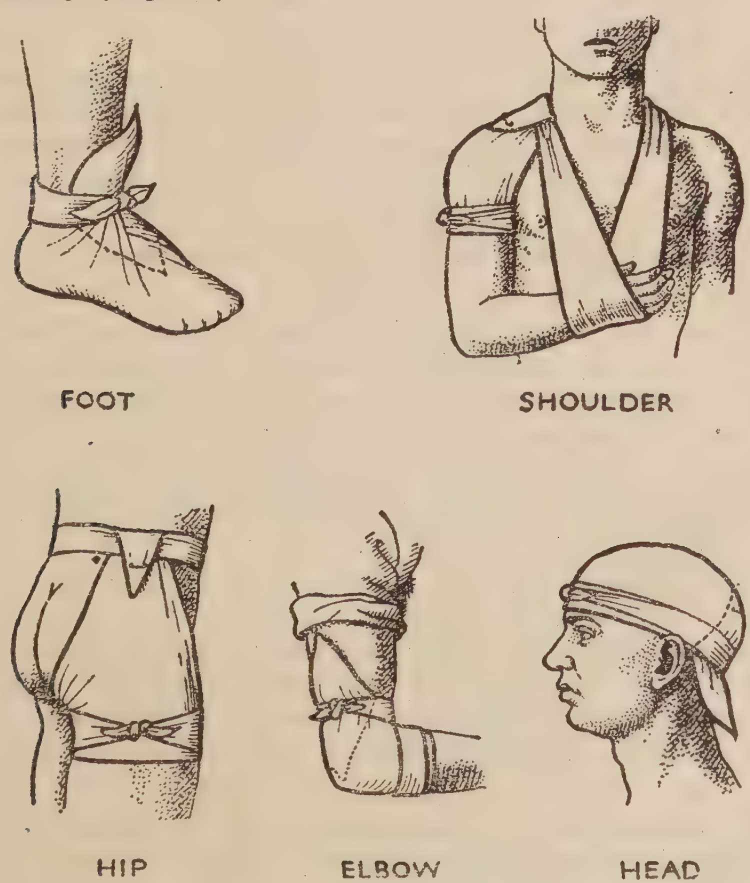


FIG. 40.—USE OF TRIANGULAR BANDAGES FOR HOLDING DRESSINGS IN POSITION.

Top of the head.—To secure a dressing on the top of the head, take a whole-cloth and lay it over the head with the point towards the back and the lower border lying along the forehead, just above the eyebrows. Make a short fold in the lower border, and pass the ends round to the back of the head above the ears. Cross the ends over the point of the bandage (which should be hanging down over the back of the neck), bring the ends to the front again, and knot on the centre of the forehead. Place your hand on the top of the head to steady the dressing, and draw down the point until the bandage is taut. Then turn up the point, and fasten it with a safety-pin to the bandage on the top of the head.

The ends should be crossed on the back of the head as low as possible without including the ears, pressure on which is painful.

Side of head.—Place the centre of a narrow-fold over the dressing. Pass the ends horizontally round the head, cross, and knot over the dressing.

A narrow-fold bandage may be used similarly to secure a dressing over the eyes, face, chin or neck.

Chest.—Apply the centre of a broad-fold over the dressing. Pass the ends round the chest, and knot on the other side, leaving a long end. Take a narrow-fold, tie it to the long end, bring it over the shoulder, and pin it to the broad-fold over the dressing.

Abdomen.—Place the centre of a broad-fold over the dressing and knot on the side.

Shoulder.—Lay the centre of a whole-cloth on the top of the shoulder with the point upwards and the lower border lying across the middle of the arm. Fold in the lower border, carry the ends round the arm, cross them and knot on the outer side. Apply the lesser arm-sling, draw the point of the first bandage under the sling, fold it back on itself and pin over the shoulder.

Elbow.—Place the centre of a whole-cloth over the back of the bent elbow, point upwards. Turn in the lower border and pass the ends round the forearm ; cross them in front, pass them up round the arm, cross them behind and knot in front. Tighten the bandage by drawing on the point, which is then brought down and pinned. Apply the greater arm-sling.

Hand.—Place the centre of a narrow-fold over the dressing and bring the ends to the opposite side of the hand ; cross them, take two or three turns round the wrist, and knot. Apply the greater arm-sling.

Hip.—Take a narrow-fold, apply it round the waist, and knot in front. Then take a whole-cloth, place the centre over the hip, point upwards, with the lower border, which should be folded in, lying across the thigh ; pass the ends round the thigh, and knot on the outer side. Draw the point upwards beneath the bandage round the waist, turn it down and pin.

Knee.—Keep the leg straight and apply a broad-fold to the knee. Cross it behind, and knot it in front below the knee-cap.

Foot.—Place the sole of the foot on the centre of a whole-cloth, toes towards the point, and turn the point upwards over the instep. Take one of the ends in each hand close up to the foot, bring them forward and cross them over the instep, covering the point. Draw the point upwards to tighten the bandage, and fold it towards the toes. Carry the ends back round the ankle, and cross them behind, catching the lower border of the bandage. Bring the ends forward, cross them again over the instep (covering the point), carry them beneath the foot, and knot on the inner side.

Other parts of limbs.—For any other part of the limbs, a broad-fold is used, with its centre over the dressing. The ends are passed round the limb and knotted over the wound.

Perineum and lower part of abdomen.—The perineum is the region round the anus. To secure a dressing there, take a whole-cloth (lower border uppermost), pass its ends round the waist immediately above the hips, and knot behind, leaving one end long. Pass the point between the legs, draw it upwards, and knot it to the long end behind.

Another method. Apply a narrow-fold bandage round the waist. Pass one end of a second narrow-fold beneath the waist bandage at the centre of the back, fold this end over and secure it with a safety-pin. Then bring the other end forward between the thighs up to the waist bandage in front, and fix it there in the same way. This forms a modified T-bandage.

107. To fix splints.—Triangular bandages are used mainly in first-aid, and are especially valuable for fixing splints. For this purpose they may be applied either as a narrow-fold or as a broad-fold—whichever is more suitable.

> Adjust the splints ; lay the centre of the bandage over the outer splint, and pass the ends round the injured limb (Fig. 41a). Cross the ends over the inner splint ; bring them back, and tie them over the outer splint in a reef knot.

If it is difficult to pass a bandage under a limb, proceed as follows :—

Double the bandage on itself to form a loop and push this loop under the injured limb from without inwards. Carry the loop round the inner splint and then over the limb, until it lies over the outer splint. The ends lie free. (Fig. 41 b.)

Pass the ends through the loop from opposite directions and tie them over the loop in a reef knot. The knot should lie over the outer splint.

Whenever it is difficult to pass a bandage under the body or under a limb, it can be looped over the end of a thin flat splint (or something similar) and then pushed to the other side.

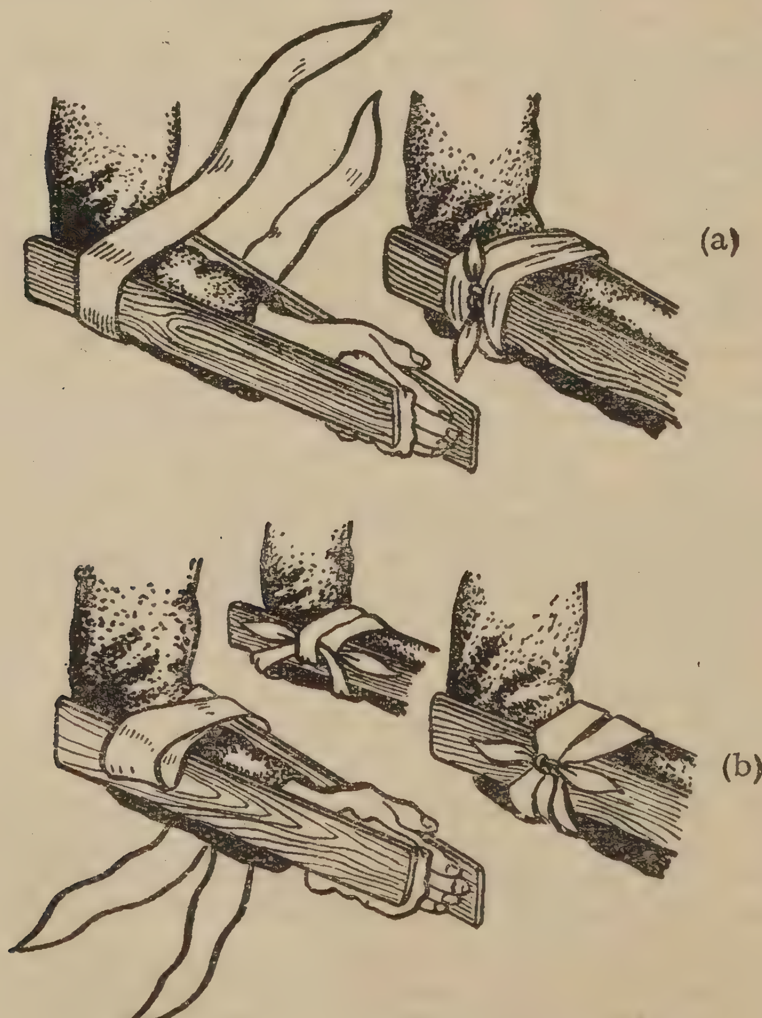


FIG. 41.—TWO WAYS OF FIXING SPLINTS WITH A TRIANGULAR BANDAGE.

CHAPTER 17

ROLLER BANDAGES

108. These are the bandages in general use. They are strips of material of various lengths and widths. Narrow bandages are 2 yards long, medium bandages 4 yards, and broad bandages 6 yards or more.

Common sense shows which width of bandage should be used for different parts of the body. For a cut finger a narrow (1 inch) bandage is indicated; for a head or arm injury a medium (2 or 3 inch) bandage; for the chest or abdomen a broad (3 or 4 inch) bandage.

Ordinary roller bandages are made of loose-woven material. Flannelette bandages are used for warmth or sometimes because of their elasticity. Muslin bandages are employed with plaster-of-paris. Crepe bandages provide slight elastic pressure.

When not in use, a roller bandage is lightly rolled on itself in the shape of a compact cylinder. After use it must be carefully rolled up again—not too tightly, for this puts a strain on the material, and not too loosely, for a loosely rolled bandage is difficult to handle when bandaging a wound.

109. Rules for bandaging.—Apply the roller bandage as follows:—

(*a*) Stand or sit opposite the patient.

(*b*) Place the limb in the position it is to occupy when bandaged.

(*c*) Take the roll of bandage in the right hand when bandaging a left limb, in the left hand when bandaging a right limb.

(*d*) The outer surface of the bandage should be next the skin. Not more than 4 inches should be unrolled at a time.

(*e*) Fix the bandage with two or three turns.

(*f*) Bandage from below upwards, and from within outwards, over the front of the limb.

(*g*) Use uniform pressure throughout.

(*h*) Let each turn overlap two-thirds of the one before.

(*i*) Keep all margins parallel and let the crossings and reverses be in one line and rather towards the outer aspect of the limb.

(*j*) Secure the bandage with a safety-pin, or by tying.

The bandage must not be put on so tightly as to cause discomfort or swelling of the limb below. It is possible for a very tight bandage to cause gangrene in a limb by cutting off the blood-supply. If, after squeezing a finger-nail (or toe-nail) in each limb, the colour returns more slowly on the bandaged side, or does not return at all on that side, it is clear that the bandage may be too tight.

110. Spirals and turns.—One of the tests of good bandaging is that the bandage lies evenly.

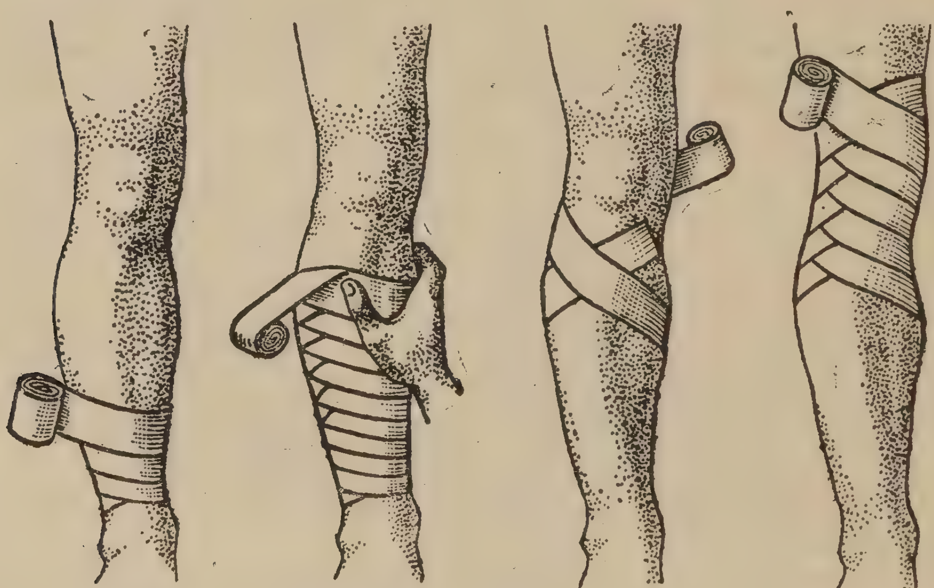


FIG. 42.—SPIRALS AND TURNS.

Simple spirals.—From the wrist or ankle the bandage is taken up the limb in simple spirals. Each turn should overlap two-thirds of the turn below, and care must be taken to keep the spacing equal, and to see that the lower edges of each turn are parallel (Fig. 42).

Reverse spirals.—When the swell of the limb is reached, the spiral bandage will no longer lie evenly and it becomes necessary to use the reverse spiral (Fig. 42).

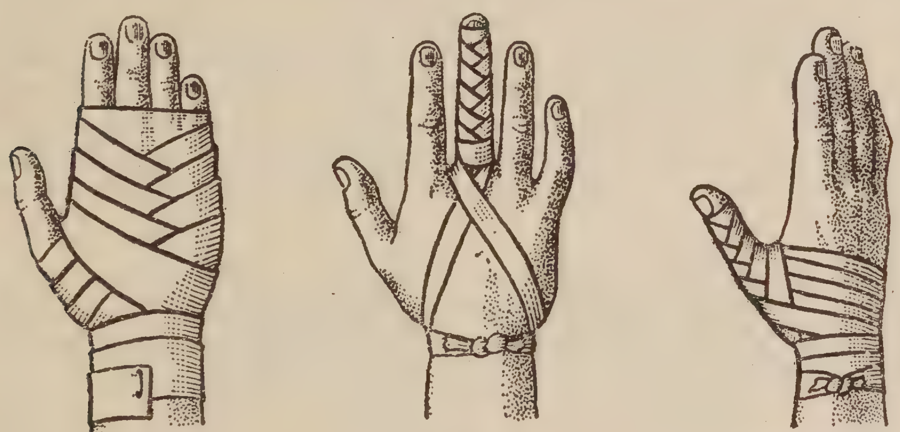
To make the reverse, the thumb of the disengaged hand is placed on the lower border of the bandage on the outer side of the limb; the bandage is slackened and turned over, reversed downwards, and passed round the limb to the opposite side, its lower edge parallel with that of the turn below. On

reaching the outer side, the reverse is again made, and so on up to the joint. The angles formed by the successive reverses must be kept in a straight line.

*Figure-of-*8.—When the joint is reached, neither the simple nor the reverse spiral will lie evenly, and a figure-of-8 is required. The roll is passed obliquely round, alternately upwards and downwards, the turns resembling the figure 8. Each completed figure should overlap the one below by two-thirds of the width of the bandage, and the crossings should be kept in the same line as the reverses below (Fig. 42).

Removal of bandage.—Unroll from the top and gather the slack up into a ball, passing it from hand to hand round the limb.

111. Roller bandages in various regions.—Application of bandages to various parts of the body should be practised.



HAND FINGER THUMB

FIG. 43.—BANDAGES FOR THE HAND.

Finger (Fig. 43).—Take a 1-inch finger bandage, make two turns round the wrist, and bring the bandage across the back of the hand to the base of the injured finger. Then run down the finger to the tip with a non-overlapping spiral and back to the base with a simple spiral. Finally take the bandage across the back of the hand to the side opposite the starting-point, make one or two turns round the wrist, and tie or pin.

Hand (Fig. 43).—Take a 2-inch bandage, and, with the patient's hand palm downwards, make two turns round the wrist to prevent slipping. From the inner side of the wrist carry the bandage obliquely across the back of the hand to the base of the little finger, then across the palm and round between

the index finger and thumb (or outside the thumb if it has to be included), and across the back of the hand to reach the base of the little finger again; across the palm to the base of the index finger (or the base of the thumb). Then obliquely across the back of the hand to the outer side of the wrist, round the front of the wrist, and obliquely across the back of the hand to the base of the little finger, thus forming a figure-of-8, which may be repeated as often as required.

Foot.—The method of bandaging is similar to that used for the hand. Make two turns round the ankle, and then from the inner side of the ankle carry the bandage obliquely over the instep to the outer side of the foot; across the sole, over the instep, and across the sole again to the inner side of the foot; then obliquely to the outer side of the ankle, and continue figure-of-8 as required.

Chest.—Take a 6-inch roller bandage 6 yards long, and apply it from below upwards in a single spiral, each spiral overlapping the one below for half its breadth. On completion of the last spiral, pin the bandage behind, leaving about 1½ yards free. Bring this free end over one shoulder as a brace, and carry it obliquely downwards in front as far as the lowest turn. Fasten it to the lowest turn and also to the upper turns to prevent slipping.

Abdomen.—The method of bandaging is the same as for the chest, except that the bandage may be applied from above downwards. To keep it in position bring the free end forwards from the back between the thighs and fasten in front.

Head.—Small wounds of the forehead, temple, and back of the scalp may be bandaged by a few circular turns of a 2-inch bandage.

When pressure has to be applied to a bleeding-point over the temple, put a pad of gauze or lint on the wound and unroll about a foot of bandage, leaving it as a loose end for knotting later. Run the roll over the pad, round the forehead and round the back of the head. When it comes back to the bleeding-point, make a sharp twist, and carry the bandage down under the chin, and then up over the top of the head. On reaching the temple again, make another sharp twist and continue horizontally. Continue to make alternate vertical and horizontal turns until pressure is sufficient. Then knot the bandage to the loose end left at the start.

Universal head bandage.—Take a 2-inch roller bandage; start just behind the left ear, and pass to a point immediately below the back of the skull, which we will call point A. Then

obliquely upwards and forwards, round the right temple, to a point in the middle line at the top of the head, point B.

Now come down across the angle of the left jaw, and under the chin ; then up again, over the angle of the right jaw, to cross the first turn at point B. Continue over the left temple, cross the starting-point behind the left ear, thereby holding firm the beginning of the bandage, and come back to point A.

Now carry the bandage horizontally, under the right ear, across the chin, under the left ear, and so again to point A. Then upwards and forwards above the right ear, across the forehead, downwards and backwards above the left ear, and so again to point A.

Repeat layer over layer, making the last turn across the jaw a vertical one, and the last turn of all a horizontal one round the forehead.

This bandage will retain dressings on the scalp, face and lower jaw.

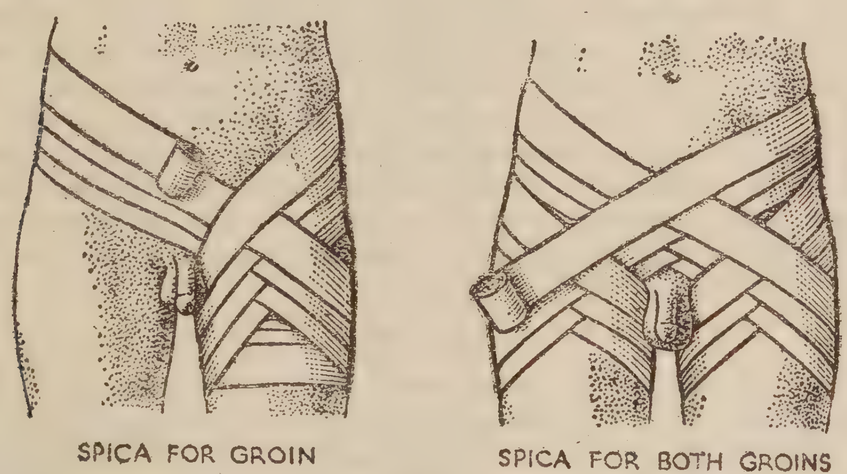


FIG. 44.—SPICA BANDAGES.

Spica bandage.—This may be applied to the groin, shoulder or thumb, using bandages of appropriate width. It consists of a series of overlapping figure-of-8 turns.

To apply a spica bandage to the groin (Fig. 44) take a 3-inch bandage and make two turns round the thigh, from within outwards, to prevent slipping. Then pass it upwards and outwards over the groin above the hip, round the back to the other hip, and across in front of the abdomen ; then downwards and outwards over the outer side of the thigh below the hip, across the back of the thigh, and up between the thighs to complete the figure-of-8, which is repeated as many times as required.

CHAPTER 18

SPECIAL BANDAGES

112. T-Bandage.—To prepare this bandage take a strip of 3-inch roller bandage $1\frac{1}{2}$ yards long and sew on to it, at its middle, a similar strip 1 yard long, thus forming a T. Split the free end of the shorter strip lengthways, far enough to allow the two ends so formed to be brought up on each side of the scrotum.

To apply the bandage, place the junction of the T in the small of the back, bring the ends of the long strip round the waist, and tie or pin them together in front of the abdomen. Then pass the divided shorter strip between the thighs, fastening its ends to the long strip in front.

The T-bandage is used to keep a dressing on the perineum.

113. Barrel bandage.—Unroll a 2-inch or 3-inch bandage for about 6 feet (roughly the length between the hands with the arms outstretched). Place the centre portion *under* the patient's chin, supporting a dressing if necessary, and tie the bandage in a single knot on the crown of the head (Fig. 45a). Still holding the ends loosely in the hand, unpick this knot, slipping the anterior loop forwards, and the posterior loop backwards, until they encircle the forehead and the occiput

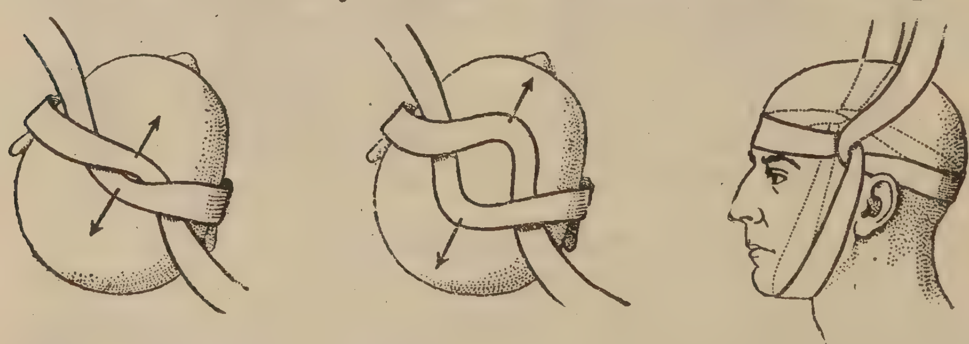


FIG. 45.—BARREL BANDAGE.

at the back of the head. (b) By a series of sideways movements slip the bandage round until each cross-over is just above and in front of the ear (c). Then tie the ends firmly on top of the head, not too far forward lest the bandage slip and become loose. Care must be taken that the portion under the chin is not placed too far back, for that would interfere with swallowing ; but it should be as far back as can comfortably be borne.

This is the best bandage for supporting a fractured mandible (lower jaw); it is much better than the four-tailed bandage described below. But when the jaw is broken on both sides *no* bandage should be applied (para. 155).

114. Four-tailed bandage.—For retaining a dressing on the chin, take $1\frac{1}{2}$ yards of 3-inch roller bandage, make a slit in its centre about 3 inches long, and then slit up the ends so as to leave 6 inches in the centre. After placing the central slit on the point of the chin, tie the two upper tails behind the neck, and the two lower tails on the top of the head (Fig. 46). The ends of the upper and lower tails should then be tied together behind the head to prevent the bandage from slipping forward.

FIG. 46.—FOUR-TAILED BANDAGE, FOR HOLDING A DRESSING IN PLACE.

If used for fracture of the lower jaw, the bandage is similarly prepared and applied, except that no chin slit is required and the centre portion of the bandage must be placed under the jaw and not on the point of the chin. This provides *upward* support; backward pressure would increase displacement of the fragments and might cause suffocation.

In tying the bandage, care must be taken not to entangle the hair. Pressure may be relieved by placing small pads of lint or cotton-wool under each knot.

115. Many-tailed bandage.—Either this is supplied ready made or it can be fashioned from strips of flannelette, or other material, laid parallel to each other and overlapping by a third of their width (Fig. 47). The strips are stitched together for a short distance from their centres, leaving the ends free. The bandage is used to retain dressings on the abdomen, chest or thigh, when one wants to be able to change them without moving the patient. It should be long enough to go round the part to be bandaged, and one quarter more.

To apply the bandage to the chest or abdomen, first cross the lowest ends over each other in front. Then do the same with the other pairs. As they overlap, each will secure the pair below. Secure the last (uppermost) pair with a safety-pin.

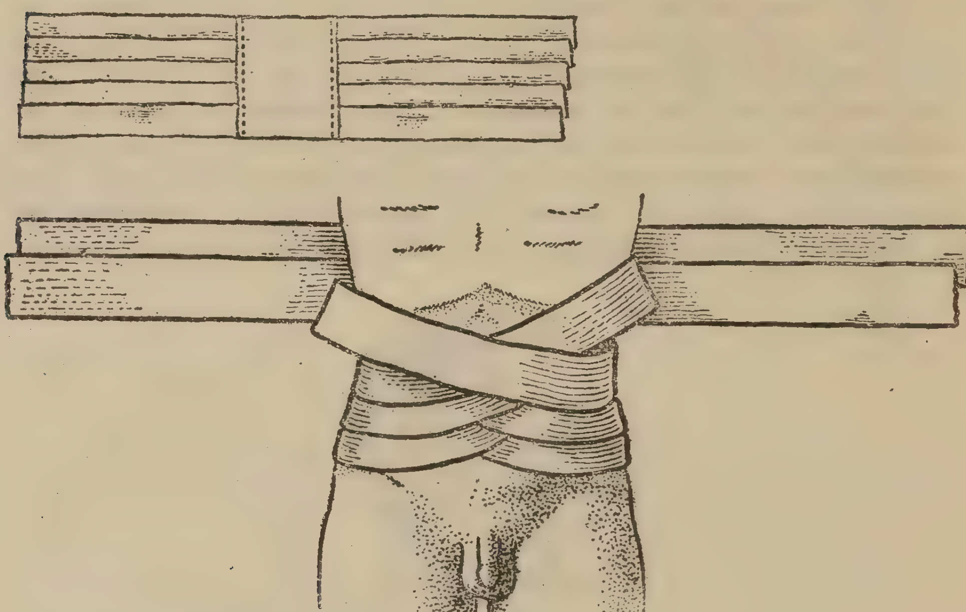


FIG. 47.—MANY-TAILED BANDAGE.

116. Elastic adhesive bandages.—These are made of cotton fabric spread with a rubber adhesive compound containing about 20 per cent. of zinc oxide. The usual widths are $2\frac{1}{2}$ and 3 inches, and the length 5 yards when fully stretched. The full-length bandages are applied as simple spirals to limbs where a firm even pressure is required, either over a dressing or in contact with the skin. Short lengths of elastic adhesive bandage or non-elastic adhesive strapping are used for holding a dressing on wounds, particularly after operation incisions. Some skins are sensitive to the adhesive and occasionally the bandages have produced a troublesome rash.

CHAPTER 19

THE FIRST FIELD DRESSING

117. A field dressing forms part of the kit of every British soldier on active service, and is therefore available at all times and places for immediate application to wounds. It is carried in the special pocket provided in the battle-dress trousers in front of the right thigh.

118. The dressing and its coverings.—An outer cover of khaki cloth encloses two complete dressings. Each dressing is a pad of gauze, with a bandage attached, enclosed in two wrappings. The pad and bandage have been sterilized, and to make sure that they remain free from germs they are wrapped in parchment paper. Outside the parchment is a waterproof cover made of jaconet. In more detail, each dressing consists of :—

A loose-woven khaki bandage $2\frac{1}{2}$ yards long and $2\frac{1}{2}$ inches wide.

A piece of bleached cotton gauze 36 inches by 23 inches which has been impregnated with an antiseptic, acriflavine. This is folded into a pad 4 inches by $3\frac{1}{8}$ inches.

One safety-pin wrapped in waxed paper, which is loosely stitched to the inner cover.

The gauze is folded. The inner surface is the one that has to be placed on the wound, and this inner surface must not be touched by the hands of the person who applies the dressing. The short end of the bandage is folded into pleats. The long end is loosely rolled on itself up to a point 18 inches from the pad and secured by a stitch to prevent unrolling. The stitch is easily broken without tearing the bandage. The remaining 18 inches of bandage between the roll and gauze pad is folded into pleats.

119. Use of the dressing.—The following directions will be found on the inner cover :—

Tear apart at the uncemented corner, as indicated by the arrow, and remove the paper.

Take the folded ends of the bandage in each hand, and, keeping the bandage taut, apply the gauze pad to the wound and fix the bandage.

DO NOT HANDLE THE GAUZE OR WOUND

These directions explain themselves and need little comment. Before applying the dressing, cut away enough clothing to expose the wound fully. Do not attempt to " clean up " the wound or to wash away blood. When the ends of the bandage are made taut, the gauze pad is unfolded. Apply it at once to the wound, taking care not to touch its inner side. There is no harm in touching the outer side, if necessary, to prevent slipping.

SECTION III.—FIRST-AID

CHAPTER 20

PRINCIPLES OF FIRST-AID

120. For successful first-aid two things are needed—common sense and some elementary knowledge. Common sense without knowledge is more useful than knowledge without common sense, but the first-aider must learn to use both. Knowledge breeds confidence, and he must know enough to feel confident in tackling an emergency.

The first thing to remember is that the man who loses his head loses his common sense. Accidents are often alarming to the inexperienced, but anyone who keeps cool is likely to do the right thing. The good first-aider, whatever the circumstances, remains calm ; he does not do things because he is scared and feels he must do something ; he does them deliberately, because they need doing. His motto is LOOK, THINK and then ACT.

Many people imagine that first-aid is something that has to be done in a great hurry. Actually haste does more harm than good and there is always time to look and think. Nevertheless, there are a few situations in which one must think and act quickly in order to save life :—

(*a*) *Severe hæmorrhage.*—The man may bleed to death if you do not stop it.

(*b*) *Inability to breathe.*—His airway may be obstructed by a lump of food, or (if he is unconscious) by his tongue, or (if he is nearly drowned) by water ; or he may have stopped breathing because of poisonous fumes or electric shock. Prompt clearance of the airway, and/or artificial respiration, may make all the difference.

(*c*) *Poisoning.*—A person who has taken poison *may* need an emetic to make him vomit, or something to neutralize the acid or alkali in his stomach. Poisoning by snakebite also calls for speedy action.

Apart from these emergencies (which are discussed in the next few chapters) there is seldom any great urgency, and it is better to do the right thing slowly than the wrong thing quickly. Hasty, rough or inconsiderate treatment is bad for the sick and injured. Be firm and persistent, but gentle.

121. Two objects.—The first object of first-aid is of course to remove any danger immediately threatening the patient's life. Several dangers of this kind have already been mentioned —namely, hæmorrhage, inability to breathe and poisoning.

The second object of first-aid is to prevent any worsening of the patient's condition before he comes under the care of a medical officer. The ways in which this can be done are mostly a matter of common sense : for example, wounds and burns must be covered with a dressing so as to protect them and keep out germs ; and broken bones will usually have to be supported with splints, bandages or slings, so that their sharp ends do not move about and do more damage than they have done already. Not quite so obvious, however, are the measures that have to be taken to guard the patient against the form of collapse known as *shock*, which in practice may prove more dangerous than the actual injury.

If a man is allowed to die of shock it will be little consolation to know that his fracture was splinted correctly ; and constant attention to the possibility of shock is one of the marks of the well-trained first-aider.

122. Shock.—When something unpleasant happens to a person—whether it is a wound, a fracture, hæmorrhage, a blow on the head, exposure to bomb blast, or partial suffocation —he will always suffer in some degree from *primary shock*. His nervous system is upset for a time, and this affects the action of his heart, which may beat feebly. He may merely feel shaky for a few seconds ; or he may faint for a few minutes ; or he may pass into a state of collapse lasting a long time. He looks pale, his pulse is rapid and feeble and may be irregular, and his skin is cold and clammy.

Symptoms of this kind which persist in spite of treatment, or come on more than an hour after the injury (*secondary shock*), may be partly due to a nervous disturbance, but their chief cause is usually a shortage of fluid in circulation. Secondary shock is often seen in patients who have lost much blood or have had a serious fracture or crushing injury or burn, causing blood or plasma to escape from the blood-vessels into the tissues.

Whatever the cause of the shock, however, the first-aid treatment follows the same lines. The five possible remedies are :—

Rest.
Warmth.
Relief of pain.
Reassurance.
Fluids.

(*a*) Keep the Patient at Rest.—The inexperienced orderly is inclined to look at the injury rather than the patient. Sometimes he does not notice or remember shock until the patient, who has perhaps been standing or sitting, slumps unexpectedly on the floor. Experience shows that even with trivial injuries, such as a cut finger, it is always wise to make the patient sit down while the wound is treated; and if the damage is at all serious he had better lie down. If he lies down it will be easier for the heart to keep up the supply of blood to the brain and so prevent fainting.

When an injured person shows signs of shock it is a good plan to keep his head a little lower than his feet—*e.g.* by raising the foot of the stretcher about 9 inches. This should not be done, however, if he has a head injury, because excess of blood in the head is to be avoided. Nor should it be done when the chest is wounded or damaged—for it would cause the abdominal organs to press upwards against the diaphragm and thus make breathing more difficult—or when there is a penetrating wound of the abdomen.

(*b*) Keep Him Comfortably Warm.—The person with shock has a cold clammy skin and often he complains of feeling cold. Shock is commoner and more serious in cold weather than in hot weather. Cold is dangerous to the sick and injured, and an important part of first-aid is not to let the patient be chilled.

In the first place it is inadvisable to remove clothes unnecessarily. Wounds must be laid bare, but it is often better to cut a sleeve or trouser (preferably along the seams) rather than take it off.

As soon as possible the patient should be wrapped in blankets, and these should be arranged so that there are several layers *beneath* him; it is little use to put a lot on top of him if his back is rapidly cooling by loss of heat into wet ground or through the canvas of a stretcher.

The best way to use two blankets is shown in Fig. 48.* The patient has four layers beneath him and two layers above; the amount of tuck-in at the side makes it impossible for the blankets to blow off or fall off; and the feet are enveloped so that no draught enters at the bottom. If a third blanket is available it may be doubled lengthways and laid over the patient before the other ones are folded over him.

The number of blankets should depend on circumstances. In cold weather several blankets, and perhaps hot bottles, may be needed to prevent chill. But over-heating, like cold,

* This method was evolved by Civil Defence ambulance workers at Wanstead.

can be harmful, and the patient must never be warmed till he sweats. It is wrong to bake him or give him a turkish bath. He should be just comfortable.

(c) Relieve his Pain.—Pain often causes shock, and the continuance of pain will make it worse. First-aid is designed to relieve pain when possible.

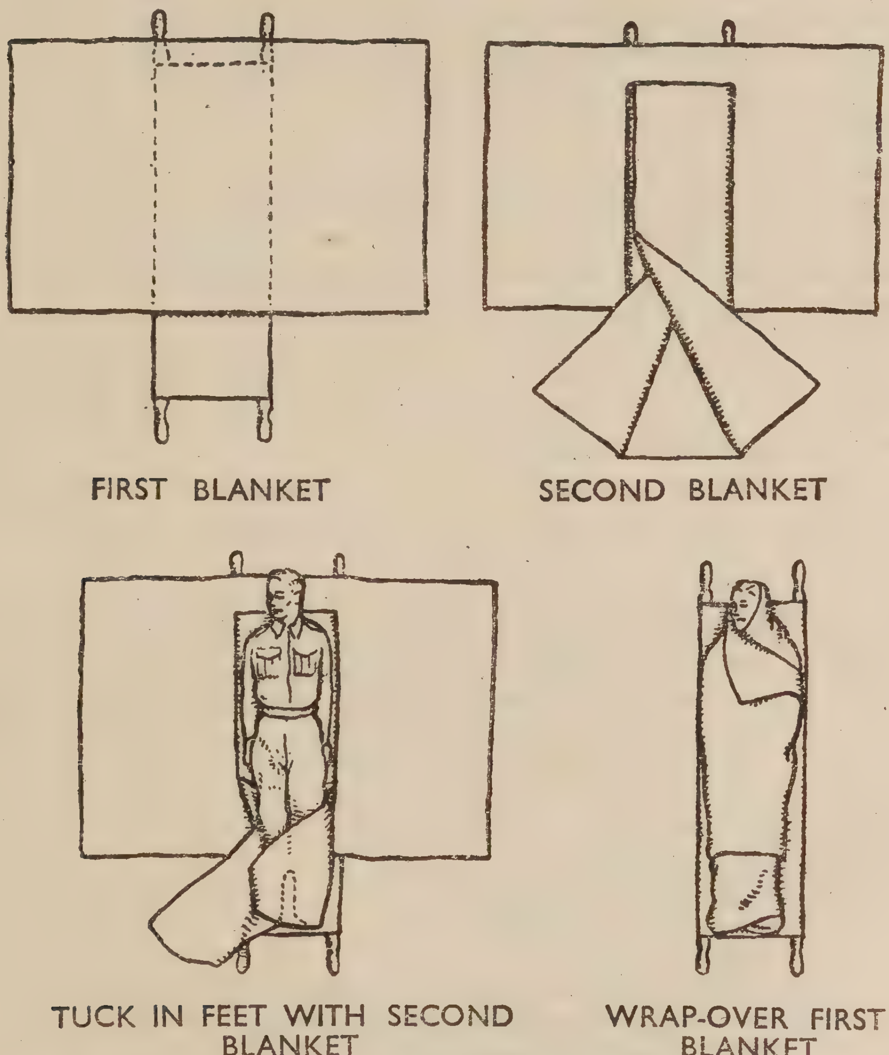


Fig. 48.—Best Use of Two Blankets to keep a Patient Warm.

Consider, for example, the pain of a fracture. The patient may be fairly comfortable without splints while he stays where he is; but it will be very different in a jolting ambulance. Proper support for a broken bone will prevent much pain in the journey to hospital.

Morphine is often helpful for relieving pain. Except under battle conditions, however, it is given only by medical officers.

(*d*) Reassure Him.—Even if there is little pain, the nervous balance of the patient may be upset by anxiety or fear : when people are wounded or injured, even slightly, they often think they will die, or at least be permanently disabled ; and such fears, by lowering their vitality, may actually hinder recovery. Whatever the orderly's private opinion, he must always appear to be quite sure that all will be well in the end. This will usually be true, for modern surgery can work miracles.

(*e*) Give Him Fluids.—As most people know from personal experience, pain and anxiety are harder to bear when one is tired and hungry ; and after most kinds of wounds and accidents a mug of hot sweet tea is a godsend to the patient. To prevent collapse later, from secondary shock, the wounded and injured should be encouraged to take as much fluid as they can, especially if sweating and lack of water has made them dry before they became casualties. To this rule, however, there are two important exceptions :—

(i) Do not give water or any other liquid to a patient who is unconscious and *cannot swallow.* It may go down into his lungs.

(ii) Do not give water or any other liquid to a patient whose *stomach or bowel* may have been *perforated.* (This includes not only all patients with penetrating wounds of the abdomen but also those with penetrating wounds of the chest or buttock, which sometimes pass through the gut.)

123. Essentials of first-aid.—We can now summarize first-aid as follows :—

I. *To Prevent Immediate Death*

Check dangerous bleeding.
See that the patient can breathe freely, and in suitable cases perform artificial respiration.
Treat poisoning promptly.

II. *To Prevent the Condition Getting Worse*

Cover wounds or burns with sterile dressings.
Splint or bandage broken bones.
Prevent or treat collapse from shock by rest, warmth, relief of pain, reassurance, and (provided the patient can swallow and his stomach and bowel are undamaged) fluids.

CHAPTER 21

BLEEDING OR HÆMORRHAGE

124. Hæmorrhage always means escape of blood from a blood-vessel ; and the object of treatment is always the same —to stop the bleeding. But circumstances alter cases, and it is useful to classify hæmorrhages according to their situation (from the body or inside the body) ; their source (artery, vein or capillaries) ; and their time of onset (immediately after wounding, or later).

Success in treatment is more likely if the type of hæmorrhage is recognized from the first.

125. Varieties of hæmorrhage.—Hæmorrhages are usually classified :—

A. According to Situation

External.—Blood escapes from a blood-vessel to the outside of the body.

Internal.—Blood escapes from a blood-vessel into the tissues or internal organs or into one of the cavities of the body, such as the chest, abdomen, intestine or skull. Such blood may later be vomited, or coughed up, or passed through the bowel ; or it may remain invisible. Hence recognition of internal hæmorrhage may depend on indirect evidence of blood loss—*e.g.* weakness, pale colour and fast pulse.

One form of internal hæmorrhage is often recognized easily. When blood from a damaged vessel finds its way into the tissues just under the skin, it produces a purplish stain. The typical appearance is seen in the bruise developing after a blow.

B. According to Source

Arterial.—The blood coming from an artery is bright red and escapes under considerable pressure. If the end of the severed artery is free, blood may be seen to escape from it in jets corresponding with the heart beats ; but this cannot be seen in a deep wound, when the blood wells up rapidly.

Venous.—The blood coming from a vein does not escape with the same force, but with a steady flow. It is dark red at first, but tends to get brighter when exposed to the air.

Capillary.—Bleeding from capillaries is typically seen in wounds involving only the skin. Though occasionally brisk at first, particularly in wounds of the face, it tends to cease spontaneously and is readily controlled.

Note.—Whenever there is arterial hæmorrhage there is bound to be venous and capillary hæmorrhage as well.

C. According to Time of Onset

Primary.—Bleeding at the time the blood-vessel is injured.

Reactionary.—Bleeding within the next 24 hours. The pressure of blood in the arteries is often low after an injury, but rises again later. A rising pressure may dislodge blood clot which has temporarily sealed a damaged vessel.

Secondary.—Bleeding more than 24 hours after injury, (usually a week or 10 days later). The chief cause is invasion by germs (*sepsis*) which breaks down blood clot or opens up a blood-vessel.

External Hæmorrhage

126. Arrest of hæmorrhage is of great importance, especially when there will be long delay before the patient reaches a surgeon. Loss of blood, either quickly or by slow oozing from a large wound, may make a man too weak to undergo a surgical operation necessary to save his life when he reaches the operating centre or C.C.S.

127. Natural arrest of hæmorrhage.—The body has two ways of checking loss of blood :—

(*a*) Though blood is fluid while it remains in the blood-vessels, it tends to clot when it escapes from them. If the vessels are small they are easily sealed by blood clot, and for this reason a capillary hæmorrhage will usually stop in a few minutes. With larger vessels, on the other hand, the stream of blood may keep on washing away the clot before it can harden.

(*b*) When an artery is torn, its elastic inner coat curls up inside and thus helps to stop bleeding. (A clean cut through the artery does not have the same effect ; so cutting wounds as a rule cause more hæmorrhage than crush wounds).

128. Artificial arrest of hæmorrhage.—There are two first-aid methods of stopping the escape of blood :—

(*a*) If the blood is coming from a limb, *raise* the limb.

(*b*) Apply *pressure* (i) to the wound, or (ii) to the artery at a point above the wound.

Drugs such as adrenaline are occasionally used to check bleeding (*e.g.* from a tooth socket), but they are of minor value and are unlikely to be available for first-aid.

To stop the flow of blood after a large vessel has been divided it may have to be clipped in pressure forceps or tied (*ligatured*). Merely by applying pressure, however, the first-aider will usually be able to stop the bleeding, or reduce it to a minimum, till the patient reaches a surgeon.

129. Position of the injured part.—Make the patient lie down: when lying down he is less liable to faint, either from nervous shock or from loss of blood. If the bleeding wound is in the arm or leg, raise the limb above the rest of the body. Hæmorrhage from a cut finger can often be stopped simply by raising the arm above the head. Large varicose veins wounded near the ankle will bleed furiously if the patient stands up, but will cease from bleeding if he lies down and raises his leg.

130. Application of pressure.—Pressure on the wound itself should be tried first. It will always check hæmorrhage from capillaries or veins, and may check hæmorrhage from an artery if there is underlying bone to press against. The pressure is best applied through a field dressing placed on the wound; but in an emergency, when dangerous bleeding must be stopped at once, it is justifiable to put a finger or hand into the wound to press on the bleeding-point.

Local pressure by a dressing and bandage on the wound—with elevation of the limb when appropriate—will stop most hæmorrhages. If blood oozes through the first bandage, all that is usually necessary is to cover it with a pad of cotton-wool and a second bandage.

If local pressure of this kind fails it may be assumed that a large artery has been damaged. In that case the best thing to do is to compress the artery above the wound—*i.e.* between the heart and the wound. This can be done in one of three ways:—

(*a*) *With the fingers* (*digital compression*).—By firmly pressing the artery against a bone, the flow of blood through it can be stopped. This can be done at a number of *pressure points*, indicated in Fig. 49. The pulsating artery must be found with the finger-tips so that the pressure will be applied at exactly the right place.

(*b*) *By flexing a joint over a pad.*—The blood-supply of the leg below the knee, and the arm below the elbow, can be cut off by putting a pad in the bend of the joint and flexing the joint strongly over the pad. The shirt-sleeve or trouser can be rolled up to form the pad.

(*c*) *With a tourniquet.*—A tourniquet is a mechanical device for pressing a pad against the main artery of a limb. Applied efficiently, it will completely stop the flow of blood through that artery ; which may be desirable for a short time, but also has its risks. Applied inefficiently, it may actually increase hæmorrhage ; for pressure which is insufficient to stop the arrival of blood through the arteries may nevertheless be sufficient to stop its return through the veins, with the result that the limb becomes more full of blood and bleeding consequently increases.

These methods of compression will now be described in more detail.

131. Arrest of hæmorrhage by digital compression.—Finger pressure on the artery above the wound is useful (*a*) before a dressing can be found and applied to the bleeding-point ; (*b*) when pressure over the bleeding-point does not stop the hæmorrhage ; and (*c*) when a limb has been blown off. The three most important pressure points are those for the carotid, brachial and femoral arteries.

Carotid artery.—The common carotid artery and the external carotid (which is a continuation of it), lie on the side of the neck under the front border of the muscle that runs from just behind the ear to the top of the sternum. It may be compressed against the spine by the thumb in a direction backwards and inwards (Fig. 49). This is best done at the level of the cricoid cartilage just below the thyroid cartilage or Adam's apple (Fig. 20, page 39).

Subclavian artery.—This may be compressed at the base of the neck opposite the centre of the clavicle. By inclining the head to the same side, and drawing forward the shoulder, the artery will more easily be reached by the thumb, which presses downwards against the first rib behind the clavicle (Fig. 49). Instead of the thumb one may use a key or similar article, wrapped in soft cloth.

Axillary artery.—To compress the axillary artery, raise the arm, place the fingers in the armpit and press upwards against the head of the humerus.

Brachial artery.—This may be compressed with the fingers against the inner side of the middle of the humerus. The inner margin of the biceps may be taken as a rough guide to the course of the artery.

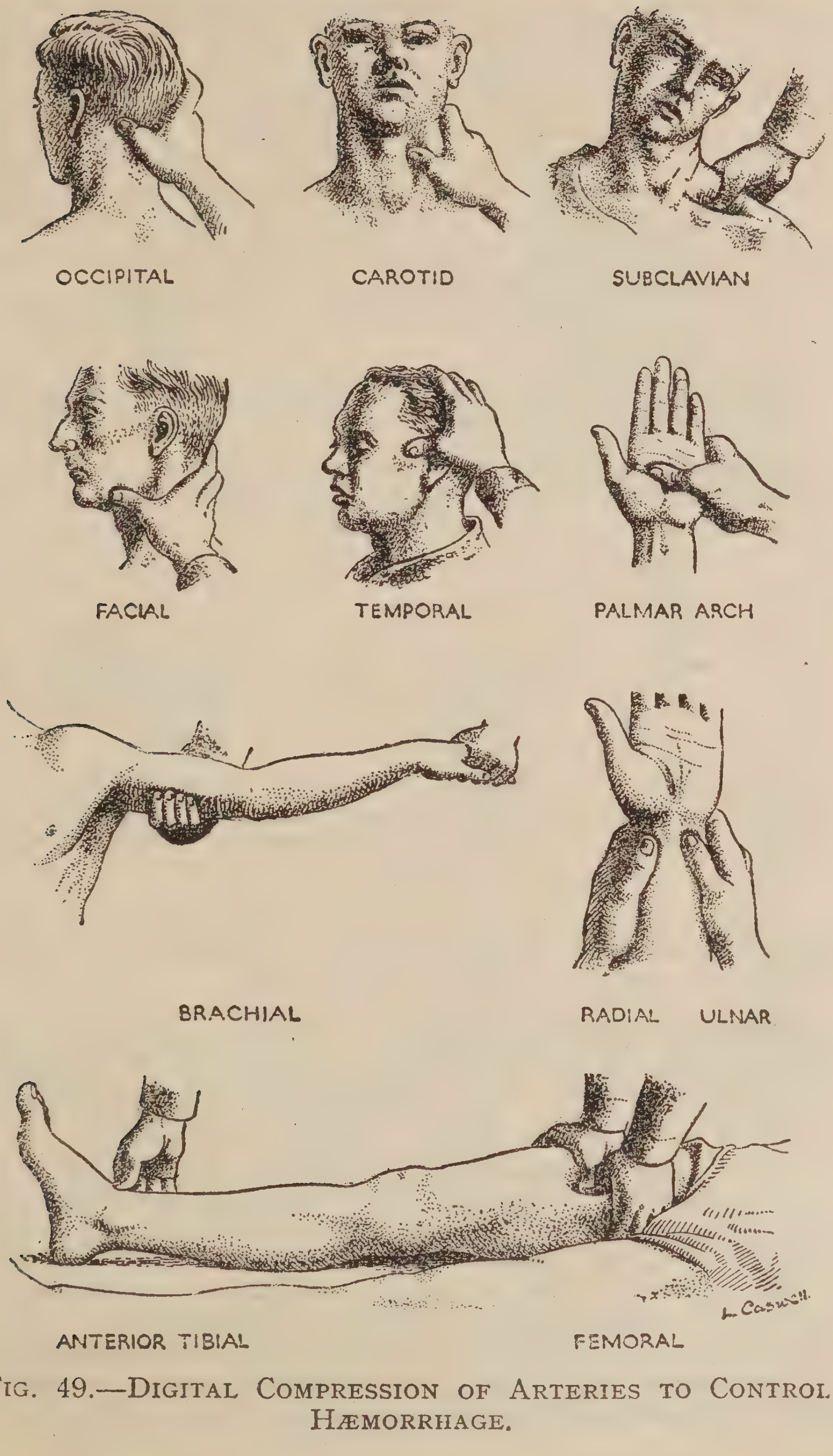


Fig. 49.—Digital Compression of Arteries to Control Hæmorrhage.

Almost fully extend the patient's arm at right angles to the body, with the palm of the hand downwards. Then, standing on the outside of the limb, grasp the arm about its middle with the fingers under the edge of the biceps muscle, palm of the hand uppermost and thumb on the outer side of the limb. The artery is then compressed against the bone by the finger-tips with pressure sufficient to arrest the hæmorrhage (Fig. 49).

If pressure is being properly applied, the pulse at the wrist will disappear. Those learning the method must make sure that they can immediately stop the pulse in this way.

The artery can also be compressed by both thumbs, like the femoral artery.

Radial and ulnar arteries.—Bleeding in the hand can be checked by pressure on these arteries at the wrist (Fig. 49).

Femoral artery.—This runs from the centre of the groin, down the inner side of the thigh, to the centre of the back of the knee joint. It may be compressed :—

(*a*) Against the hip-bone (innominate), by pressing at the fold of the groin.

(*b*) Against the upper end of the thigh-bone (femur), by pressing backwards and outwards on the line of the artery, some four fingers' breadth below the fold of the groin (Fig. 49).

Arteries of the leg and foot.—Direct pressure on the bleeding-point, or in the course of the artery above the wound, should first be tried. If unsuccessful, compress the femoral artery as above described, or flex the knee on a pad.

Temporal artery.—The temporal artery may be felt pulsating in front of the upper part of the ear and bleeding may be arrested by pressure at this point (Fig. 49).

Abdominal aorta.—It is sometimes possible to compress the aorta in the abdomen. First flex the thighs, to relax the abdominal muscles ; then press a hand backwards against the spine at the level of the navel but slightly to its left.

132. Arrest of hæmorrhage by flexion over a pad.—This method of exerting pressure on an artery is occasionally used with wounds below the knee or elbow. A pad is placed in the bend of the joint, which is then flexed as far as possible and is held in position by a bandage (Fig. 50). Flexion of this kind is painful and must not be continued long.

Flexion over a pad may also be employed to secure pressure on the wound itself. A good way of checking hæmorrhage from the palm of the hand is to apply a thick pad (*e.g.* two

clean rolled handkerchiefs) and close the patient's fingers over it so as to grasp it firmly; a bandage (*e.g.* narrow-fold triangular) is then tied over the clenched fingers and the pad is thus pressed into the wound (Fig. 51).

FIG. 50.—FLEXION OVER PAD.

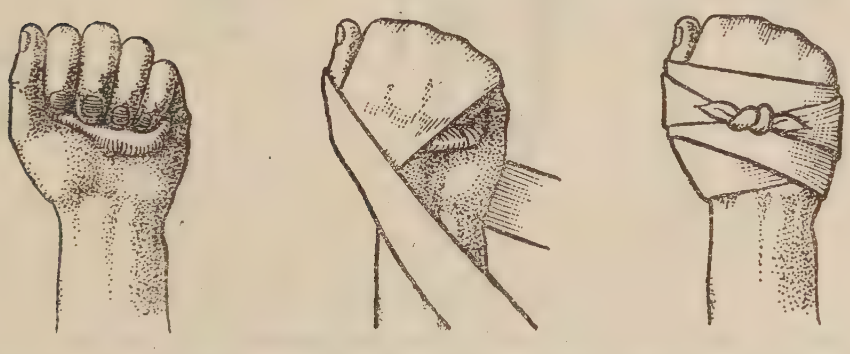


FIG. 51.—PAD AND BANDAGE FOR WOUND IN PALM.

133. Arrest of hœmorrhage by tourniquet.—Never put on a tourniquet until it is quite obvious that a pad applied directly to the wound, and firmly bandaged in position, is failing to stop the bleeding.

A tourniquet can be applied effectively in only two situations. —the upper arm and the thigh.

Until the tourniquet is ready, bleeding should be controlled by direct pressure on the bleeding-point. The tourniquet should then be put on over a thick pad of cotton-wool, if available, or over the sleeve of the coat or the leg of the trousers, to prevent damage to the skin. It should not be tighter than is necessary to stop the bleeding.

On active service, whenever a tourniquet is applied, a note to this effect must be made on the patient's field medical card

(A.F. W3118). The letter T is written on the patient's forehead, together with the time of application (Fig. 52).

Singer's tourniquet consists of a web strap and buckle attached to a metal pad and screw. The strap should be applied over a pad of cotton-wool (or the sleeve of the coat or leg of the trousers) round the limb above the bleeding-point, so that the metal pad is over the pressure-point of the artery. It is then buckled off.

Pressure sufficient to control the hæmorrhage is obtained by turning the screw, which has the effect of winding the strap on a spindle and so tightening it. When bleeding has stopped, the pressure can be released by reversing the action of the screw, while the tourniquet can be left in position for further use if required.

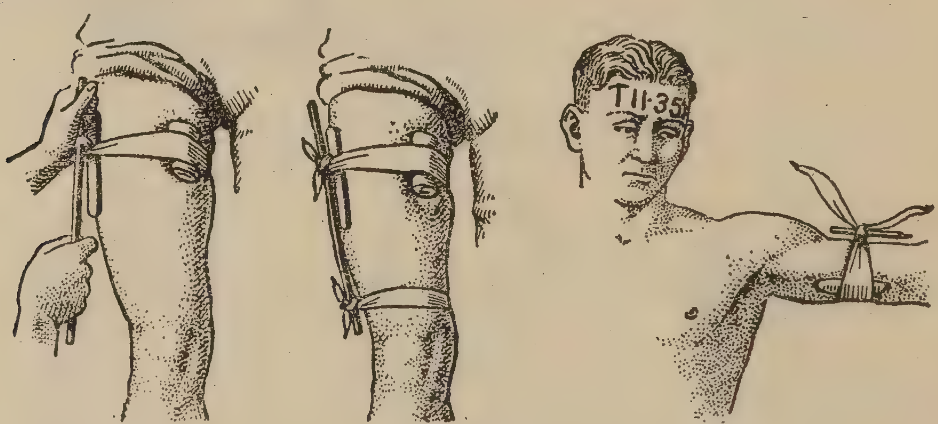


FIG. 52.—AN IMPROVISED TOURNIQUET.

The pad of cotton-wool under the tourniquet is not shown in these drawings. If no such pad is available the tournequet should be applied over the trouser or sleeve.

Samway's anchor tourniquet is a stout rubber tube with a metal clasp. The rubber is put on the stretch and passed twice round the limb, over a pad of cotton-wool or other material, enough pressure being exerted to control the haemorrhage. It is then fastened with the anchor clasp.

Improvised tourniquet.—A tourniquet can be improvised as follows :—

(*a*) Apply a small firm pad over the line of the bleeding vessel on the heart side of the wound. The pad can be made by tying a knot in a handkerchief or triangular bandage, or by rolling up a piece of cloth or any other soft substance that can be compressed into a small uniform mass.

(*b*) Encircle the limb by a broad bandage, or a puttee, or a rifle sling, which should be kept flat, with no kinks. (Narrow cords and tape should be avoided if there is any suitable alternative, for they are apt to cut into the flesh.) Tie its ends in a half knot on the side opposite the pad.

(*c*) Lay a short stick, stout pencil or similar object on the half knot, and over it tie a reef knot.

(*d*) Twist the stick to tighten the bandage, thereby causing the pad to press on the artery, and thus arrest the flow of blood. Twisting should be stopped directly bleeding is controlled.

(*e*) Lock the stick in position with the ends of the bandage already applied, or with another bandage passed round the stick and limb (Fig. 52).

It is an advantage to insert a short padded splint, or something similar, under the knot in the bandage, as shown in the Figure. This helps to prevent the skin from being caught up when the tourniquet is tightened by twisting.

134. Caution in the use of tourniquets.—As already stated, a tourniquet should be employed in first-aid only when it proves impossible to stop the bleeding in any other way. And it should not be tightened more than just enough to arrest the hæmorrhage.

A limb cannot be deprived of its blood-supply for more than a short time without serious risk; so, whenever a tourniquet has been applied, constant close supervision is necessary.

The tourniquet should be loosened for a few moments once every quarter of an hour to allow blood to flow through the tissues. If, on releasing the tourniquet, the wound does not bleed, the tourniquet should be left loose; but it should remain in place so that it can be tightened again at once if bleeding recommences while the injured man is being taken to the surgeon. In such a case an orderly should always accompany the patient.

When a tourniquet has to be tightened after loosening, its position should if possible be slightly shifted so that it does not bite into the tissues at the same point.

If a tourniquet is left on too long the limb will never recover: it may eventually be left shrivelled and paralysed, or it may even become gangrenous and have to be amputated. Of course, when an arm or leg has been blown off or cut off, this risk no longer exists, and tourniquets can then be used without hesitation, provided they are applied as low as possible. Fortunately in these cases there is often surprisingly little haemorrhage, and a tourniquet may not be needed at all.

A patient with a tourniquet should always be seen by a medical officer without delay. A note giving the time of application must go with him if he is transported to hospital or elsewhere, and the orderly travelling in charge of him must understand the necessity for loosening the tourniquet every quarter of an hour.

When tourniquets are used at operations, great care must be taken that they are removed at the end of the operation when no longer required. When hidden by clothing they may be forgotten, and serious results have followed such an accident.

A tourniquet should never be covered by dressings or bandages.

135. Effects of loss of blood.—With any serious hæmorrhage, the first task is to stop the flow of blood. When that has been done, however, the general condition of the patient should have attention. The effects of severe or long-continued blood loss are :—

(*a*) Skin is *pale* (note pallor of lips and inside the eyelids).

(*b*) Skin is *cold* and clammy.

(The amount of blood in the body has been reduced ; and, in order to keep up supplies to the vital organs, very little blood is allowed to circulate through the skin. That is why it is pale and cold.)

(*c*) The *pulse quickens* and grows weaker.

(Owing to the shortage of blood in the vessels, the heart does not fill completely between contractions. In its efforts to force enough blood out through the arteries, it beats faster but gradually loses strength.)

(*d*) *The patient becomes weak* and eventually unconscious. He may complain of giddiness or dimness of vision.

(*e*) The *breathing* is usually shallow—often with yawning and sighing.

(The loss of blood and fall of blood-pressure make it impossible to carry enough oxygen round the body).

(*f*) The patient is *thirsty* through loss of fluid.

136. Treatment for loss of blood.—In first-aid for severe hæmorrhage it is not enough to stop the bleeding. The patient must be kept warm (though by no means so hot that he sweats). He needs complete rest ; his anxiety should be calmed by reassurance, but he should be discouraged from

talking. Provided there is no reason to suspect perforation of the stomach or bowel, his thirst should be relieved by frequent drinks of water or tea, but alcohol must not be given. If he show signs of collapse, the foot of stretcher or bed should be raised 9 inches so that blood will flow more easily to the brain. —In a word, he is treated for *shock*.

Internal Hæmorrhage

137. Internal hæmorrhage is bleeding from a blood-vessel into the tissues (*extravasation*) or into one of the organs or cavities of the body. Like external hæmorrhage, it may be primary, reactionary or secondary, and may result either from injury or from disease (*e.g.* ulcer of the stomach or intestine).

Extravasated blood becomes visible when it lies under the skin, as in a bruise. Hæmorrhage of this kind is never severe and rarely calls for treatment.

Blood in the stomach may be vomited (*hæmatemesis*) ; blood in the intestine may be passed per rectum, often in the form of dark tarry stools (*melæna*) ; while blood in the lungs may be coughed up (*hæmoptysis*).

138. Recognition of internal hæmorrhage.—The existence of internal bleeding is not always obvious ; for example, if the blood is escaping into the abdominal cavity it will not become visible at all (*concealed* hæmorrhage). It should be suspected, however, if a person shows the effects of hæmorrhage described in para. 135—namely pallor, cold clammy skin, fast pulse, weakness, thirst, giddiness or collapse, and shallow sighing breathing. Suspicion deepens if there is reason to suppose that he has internal injuries, or if he is known to suffer from an ulcer of the stomach or duodenum.

On the other hand it must be remembered that much the same symptoms and signs can be caused merely by the shock that may be seen after any kind of accident. The chief differences are :—

(*a*) If a shocked patient is kept warm and at rest the pulse-rate slows. With an unchecked hæmorrhage the pulse-rate steadily rises.

(*b*) Pallor is more noticeable with a hæmorrhage. In shock the face is more grey and the lips may be purple.

139. Treatment of internal hæmorrhage.—First-aid for internal hæmorrhage is the same as for any other severe hæmorrhage, except that nothing can be done to stop the

bleeding and no drinks should be given if the haemorrhage may possibly be due to perforation of the stomach or intestine. Send at once for a medical officer, and meanwhile keep the patient comfortably warm and quiet, raising the foot of the bed if he shows signs of collapse.

Hæmorrhage in Particular Situations

140. Bleeding from varicose veins.—Veins often become enlarged, especially in the legs. The valves (Fig. 15, page 34) no longer work ; so, if the veins are cut, blood flows downwards from bigger veins higher up. By the action of gravity this loss of blood will continue so long as the patient is standing or sitting ; and it may be very alarming.

Treatment.—Lay him flat, raise his injured leg, and apply a pad and bandage to the bleeding-point. The hæmorrhage ceases at once.

141. Bleeding from the nose.—Unless it follows an injury, a nose-bleed (*epistaxis*) is rarely serious. A healthy person never suffers harm by losing a pint of blood, and it takes a long time to lose a pint through an uninjured nose.

Treatment.—This is an exception to the general rule that people with hæmorrhage should lie down. Make the patient sit and hold his own nose firmly between thumb and forefinger for five minutes. He must keep quiet and must not attempt to blow his nose. In the few cases in which nose-holding is unsuccessful he should see a medical officer.

142. Bleeding from the tongue.—This may be profuse.

Treatment.—Bring the edges of the wound together and hold them together with the fingers. If this fails, the wound will have to be stitched. If the patient becomes unconscious he must be placed face downwards, for there is danger of his drowning in his own blood.

143. Bleeding from a tooth socket.—Extraction of a tooth is sometimes followed by troublesome hæmorrhage lasting for hours.

Treatment.—Make a small firm pad of clean gauze or lint. Gently remove all blood clot from the mouth. Place the pad over the bleeding socket and tell the patient to close his teeth on it, so as to press it against the wound. Support can be given by a bandage applied to the lower jaw ; for example, the four-tailed bandage shown in Fig. 46 (page 81).

A medical or dental officer may decide to pack the socket with cotton-wool soaked in adrenaline. This drug makes the bleeding blood-vessels contract.

144. Bleeding from the lungs or stomach.—Blood which is coughed up, or spat up, does not always come from the lungs. Sometimes it can be seen trickling down into the throat from the back of the nose and the patient requires treatment only for nose-bleed. Blood from the lung is often frothy, and blood that has remained in the stomach for some time looks dark, like coffee-grounds. The exact diagnosis, however, is of little importance in first-aid, for the treatment is the same. Send for a medical officer; give nothing by mouth; keep the patient warm and at complete rest; and do not let him talk much or get excited.

145. Bleeding from the bowel.—Some hours after a hæmorrhage in the stomach or duodenum (usually from an ulcer) dark and tarry blood may be passed per rectum (*melæna*). Bright blood may be mixed with the fæces of patients with dysentery; and small quantities of bright blood are passed from time to time by men with internal piles (varicose veins in the rectum).

All these conditions require medical investigation.

CHAPTER 22

FRACTURES IN GENERAL

146. When a bone is broken, it is said to be fractured. A fracture may be due to disease which has weakened the bone so that it breaks easily. Or it may be due to violence, applied to the bone either directly or indirectly or in the form of muscular action.

Fracture by direct violence.—The bone breaks at the spot struck or crushed. An injury of this kind may be inflicted, for instance, by a kick, a bullet, or the passage of a wheel over the part.

Fracture by indirect violence.—The bone does not give way at the point struck, but breaks at another place. As examples may be mentioned fracture of the clavicle from a fall on the hand, and fracture of the base of the skull caused by falling from a height on to the feet. In the first example the violence is applied to the hand, and the shock travels up the arm to the clavicle and breaks it; in the second, the shock is transmitted from the feet, through the legs and spine, to the skull.

Fracture by muscular action.—Less often, a bone is broken by violent contraction of muscles. Fractures of the patella (knee-cap) are not uncommonly caused in this way (Fig. 53).

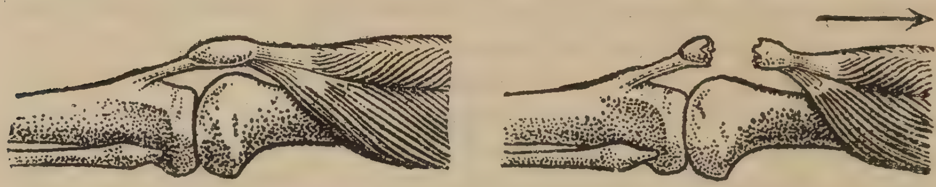


FIG. 53.—SHOWING HOW CONTRACTION OF MUSCLES CAN BREAK THE PATELLA. (FRACTURE IS MORE LIKELY WHEN THE KNEE IS BENT).

147. Varieties of fracture.—Fractures may be either closed or open.

Closed or simple fracture.—Where there is no wound leading down to the break in the bone, the fracture is said to be closed or simple.

Open or compound fracture.—When a wound goes down through the skin and soft parts to the break in the bone, the fracture is said to be open or compound. Sometimes the bone sticks out through the skin.

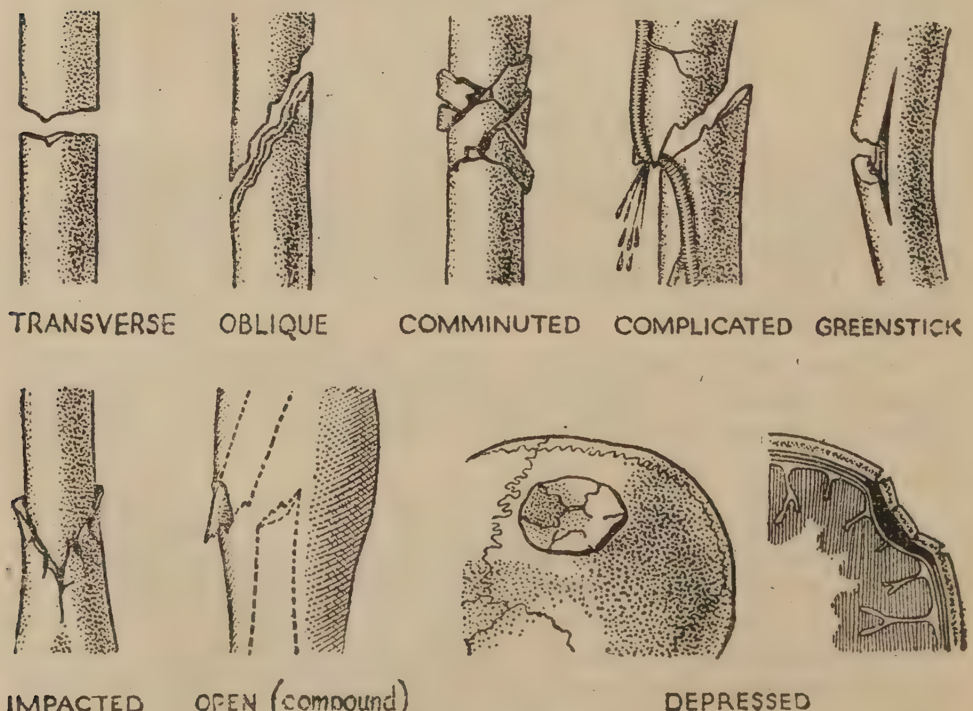


FIG. 54.—VARIETIES OF FRACTURE.

Owing to the risk of infection of the wound, open fractures are much more serious injuries than closed fractures.

A fracture (either closed or open) is described as *complicated* when any important structure besides the bone is damaged—for example, one of the larger arteries, veins or nerves of a limb, or the tissues of the lungs, liver or brain. Or a fracture may be complicated by dislocation of the bone at a joint.

Fractures are further described as :—

Complete, when the bone is broken right across.

Incomplete or *greenstick*, when the bone is partially broken or bent. This variety is chiefly seen in children, because their bones are softer.

Comminuted, when the bone is broken into several pieces or even pulverized.

Impacted, when one fragment of bone is driven into, and firmly fixed in, the other fragment.

These varieties are illustrated in Fig. 54.

148. Signs and symptoms of fracture.—When a bone is broken the patient may feel a sudden snap or giving way. The fracture may be recognized by some or all of the following symptoms and signs :—

(*a*) *Pain and tenderness* at the point where the bone is broken.

(*b*) *Alteration in shape*.—A limb may be bent, twisted or shortened, and (compared with the sound limb) its shape appears unnatural.

(*c*) *Swelling* usually develops.

(*d*) *Loss of power*.—The limb cannot be put to its proper use : for instance when a leg is broken a man cannot stand on it ; when an arm is broken, the hand cannot be raised to the back of the head.

(*e*) *Unnatural mobility*.—When the limb is handled—which ought not to be done unnecessarily—it may be movable where it should not be movable.

(*f*) *Crepitus*.—When the limb is handled there may be a grating sensation (crepitus) caused by the broken ends of the bone rubbing against one another. But no one except a medical officer should try to elicit this sign.

In examining a suspected fracture, never start by handling the injured part. First LISTEN to what the patient says about his injury, his pain, and his disability. Next LOOK for alteration in shape and for swelling.

The fact that a limb is broken may be obvious. If not, find out whether the patient can still move it normally.

Finally, if necessary, use your hands very gently to discover whether the bone is still a single whole or whether the two ends move independently of one another (unnatural mobility).

149. Treatment of doubtful cases.—If there is any doubt whether the bone is really broken, the case must be treated as one of fracture. Always handle the limb with great gentleness to avoid further injury to the part, bearing in mind that rough usage may easily convert a closed fracture into a much more serious complicated or open fracture.

150. Object and method of treatment.—The object of first-aid treatment of fractures is to prevent pain (which increases shock), and to stop the broken ends from damaging nerves and blood-vessels or from piercing the skin. To achieve these objects, the fractured bone has to be *immobilized* or fixed so that it will not move.

Many bones, including the ribs, spine and pelvis, have little movement even when fractured, and can be held in place by bandages. Others, such as the long bones of the limbs, move freely; and this movement must usually be prevented by putting on splints.

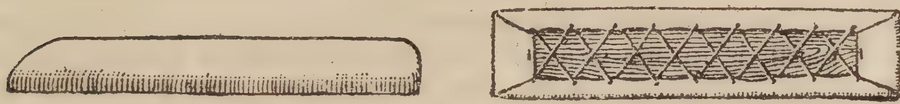
In first-aid it is seldom possible to fix the broken parts of a bone exactly in their normal places. Indeed, when a fragment has pierced the skin (open fracture) no attempt should be made to put it back again: it should be covered with a dressing, and the limb should be supported by a splint.

Nevertheless, with closed fractures, where no bone protrudes, an effort should be made to restore the lower part of the limb to its natural position before the splint is applied. This is done by drawing it downwards cautiously, but firmly, so as to overcome the spasm of the muscles and reduce overlapping by the broken fragments. If the splints can hold the limb in this position of *extension*, the contracting muscles will help to keep the broken fragments from moving sideways.

When the regulation splints are not to hand, effective substitutes can be improvised from anything firm enough to support the damaged limb. These (and any other) splints should always be padded: if cotton-wool or tow are not available, anything soft may be used, such as articles of clothing, grass or hay (Fig. 55). Bandages may be improvised from handkerchiefs, and strips torn from sheets or clothing. When there is a fracture of the upper arm, the side of the chest may be used as a splint for the broken bone; again, the sound leg may be used to support its fellow, with suitable padding between.

Bandages have to be applied firmly enough to prevent harmful movement; but it must also be remembered that a

wounded limb often swells, and that the bandage may then be too tight and interfere with the circulation in the limb. Signs of excessive tightness are an increase in pain, and blueness of the hand or foot. Care must be taken to avoid this happening,



PADDED SPLINT, SHOWING METHOD OF FIXING LINEN COVERING

IMPROVISED SPLINT, USING WOOD AND HAY

Cloth, wool, paper, straw, bracken, grass etc. may also be used for padding

FIG. 55.—PADDING OF SPLINTS.

and when a bandage is too tight it must at once be loosened sufficiently for the normal colour to return to the limb.

When a leg has been fractured, the injured person should not be moved until the fragments of bone have been fixed by some form of splint.

151. Fracture plus hæmorrhage.—When there is a fracture there is often hæmorrhage too. The following rules apply :—

(*a*) Severe hæmorrhage is the only condition that should have priority over the splinting of a fracture.

(*b*) Digital compression of the vessel above the wound is less dangerous to the limb than the application of a tourniquet.

(*c*) Every minute that a tourniquet is left on a limb reduces its chance of recovery. But it is often a good plan to put a tourniquet loosely in position so that it can be instantly tightened in an emergency.

(*d*) Immobilization of the limb by efficient splinting reduces the liability to bleeding from a vessel already injured, and prevents the tearing of uninjured vessels by a jagged end of bone.

CHAPTER 23

PARTICULAR FRACTURES

152. Fractures of the spine.—The spine can be fractured by a shell or bullet wound ; by falling from a height on the back across a bar, or on to uneven ground ; by falling on the head ; or by some heavy mass hitting the back. Through an injury of this kind, one or more of the vertebræ which form the spinal column may be broken or displaced ; and in consequence the spinal cord, which runs inside the spinal column, is liable to damage.

The spinal cord is the main nerve trunk of the body, and an injury to this nerve trunk may interrupt communications between the brain and the part of the body below the injury. At its worst this means that the patient can no longer use his muscles (*paralysis*), and no longer feel when his skin is touched (*loss of sensation*).

Diagnosis.—The spine may be fractured without damage to the spinal cord ; and when this happens there may be no evidence of the fracture except pain and tenderness, with perhaps a little bruising and swelling and some difficulty in bending the back. A man with a simple fracture of this kind will have no paralysis and may be able to walk. But if he is allowed to do so, the damaged vertebra may prove unequal to the strain thrown on it, and may collapse, severely damaging the spinal cord. So, when circumstances point to an injury to the back, it is well to be on the safe side and treat the patient as if he had a broken spine.

The two commonest sites of fracture are the neck and the small of the back. Serious damage in the back may cause paralysis and loss of sensation in the legs, buttocks and sacral areas ; also, there may be retention of urine, and faeces may be passed involuntarily. Serious damage in the neck may cause paralysis of arms as well as legs, and breathing may be difficult.

Treatment.—As a rule the patient should not be moved till a medical officer arrives. He should be covered with blankets and told to lie still. But if no medical officer is available within a reasonable time, first-aid must not be further delayed.

The first step is to place padding between the patient's knees and between his ankles, and tie his limbs together with two broad-folds (one round the thighs, one round the knees) and a figure-of-8 bandage round the ankles. To prevent pressure sores, the heels and all bony points should also be padded. Next he must be transferred to a stretcher (or other means of conveyance) ; and this will need great care.

To raise the patient, some form of support—such as a blanket, sheet or piece of canvas—is placed under him. This should be done by two, or preferably three, persons. The patient is carefully rolled on his side, his shoulders and back being supported by one attendant, while another looks after his pelvis and lower limbs. The third then rolls the canvas or blanket under him.

The position in which the patient should be placed on the blanket varies according to the position of the injury :—

If the damage to the spine is in the *back* (dorsal or lumbar region, Fig. 9, page 21), the patient is cautiously lowered on to his *face*, with a good pad of rolled-up clothing or some other material placed under the upper part of the chest (Fig. 56, top). He will be more comfortable if his pelvis and feet are also supported, as shown. The head can be turned to one side or supported in the crook of his arm.

If injury to the *neck* (cervical region, Fig. 56, middle) is suspected, the patient should be very carefully placed on his *back*, with a good pad under the shoulders to allow the head to fall well back, and additional pads placed on each side of the head to prevent it rolling about. A bandage secures the arms.

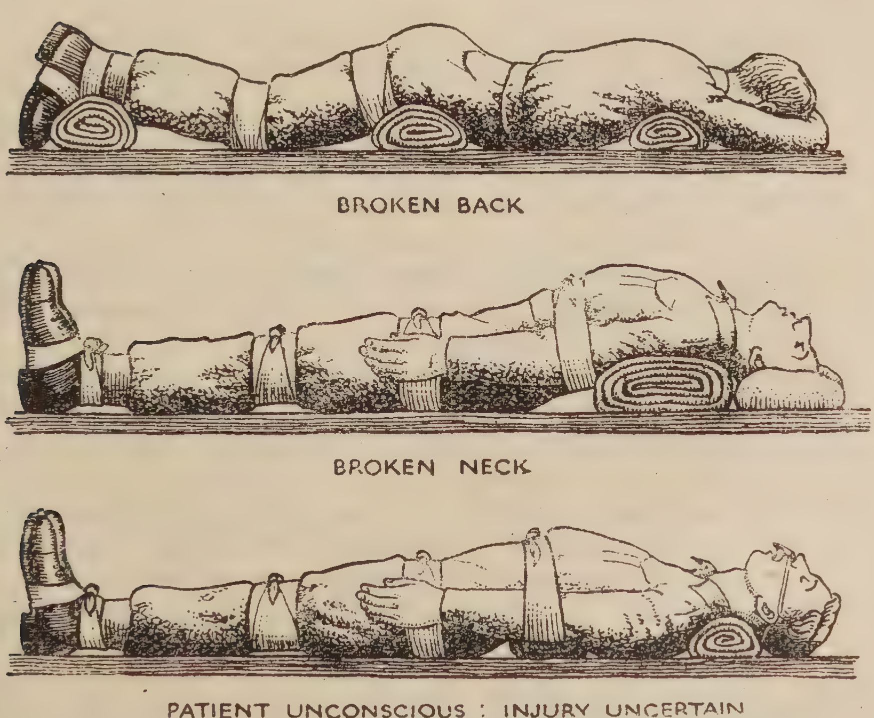


FIG. 56.—FIRST-AID FOR FRACTURED SPINE.

If the patient is unconscious, and it is impossible to decide where the injury is, he should be placed on his *back* as shown in the bottom drawing. To prevent his tongue from falling back and choking him, his jaw should be held forward by pressing behind the angle of the jaw; or a safety-pin may be passed through the tongue and secured by a piece of bandage or string passing round the neck and face just under the nose.

Another way of putting a blanket under a patient is to pass it under the head and gradually downwards to the feet. This can be done with little disturbance. Whichever method is adopted it is most important to move the body as a whole and to carry out all necessary movements very gently to prevent any jarring of the spine.

After the patient has been placed in the proper position on a blanket, poles should if possible be fixed to each side of the blanket so that it can be raised without sagging in the middle. It is then lifted—slowly and with the utmost care—and placed upon a stretcher, board or gate, which is carried, preferably by four persons, to the nearest place of shelter. The patient is kept absolutely quiet until the arrival of a medical officer.

Alternative method.—The Clarke-Moir method can be used for any spinal injury, either in the neck or back. The patient is transported "as he lies."

(*a*) Prepare stretcher with blankets. Arrange pads according to position in which patient is found lying, as follows: (i) *on back*, one for neck and one for loins; (*ii*) *face downwards*, one for shoulders, and one for hips; (iii) *on side*, small one for neck.

(*b*) Tie the legs together as already described.

(*c*) Pass 5 looped narrow-folds under the hollows of the body, from alternative directions, and work them into position under the head, shoulder-blades, buttocks, thighs and calves.

(*d*) On each side pass a pole through the loops and tie the bandages over it.

(*e*) If patient is lying on his side, support his back with pillows or blanket.

(*f*) On each side two (or preferably three) assistants grasp the poles with hands apart and slowly and evenly lift the patient. The stretcher is placed beneath him and he is lowered on to it, adjusting the pads to give the required support. See (*a*).

If the patient is paralysed and the skin of his buttocks and sacral regions has lost all feeling or sensation, there is grave risk that he will get a severe bedsore over the sacrum or other

pressure points. The only way to avoid this is to prevent his lying on the same part of his back for long at a time. Therefore the position of his pelvis should be slightly altered occasionally (every hour if possible). This can be done gently without changing the position of the fractured spine.

153. Head injury.—The patient may be quite unconscious or only dazed, and fluid or blood may come from the mouth, ears or nose.

Treatment.—Keep him quiet, lying down with the head low, until he can be seen by a medical officer. Drinks may be given if he can swallow—but no alcohol. Bleeding, or loss of watery cerebrospinal fluid, externally means that there is an open (compound) fracture ; and if germs get in they may cause inflammation of the brain. Pieces of gauze or cotton-wool moistened with antiseptic solution should (if available) be put into the ears from which blood or fluid is escaping ; but these must not be plugged so tightly that drainage is prevented.

If the patient is unconscious, his breathing may be difficult because his tongue has fallen back into his throat and blocked the airway. If so, it can be made easier by turning him face downwards. Or turn the head to one side and, if necessary, hold the lower jaw well forward by pressing behind its angle.

If there is an external wound it should be covered with a sterile dressing.

154. Fracture of the pelvis.—This is almost always due to direct violence, such as the passage of a wheel across the body. Ordinarily there is little displacement of the bones, but injury to the bladder or bowel is a serious risk. The patient cannot stand without pain, and cannot move his legs freely ; there may be a large bruise, and pain is felt when the sides of the pelvis are pressed together.

Treatment.—He should lie in the position he finds most comfortable—preferably flat on his back with the legs straight. Movement of the broken bones should be lessened by means of a broad-fold bandage (or a towel) round the pelvis ; it is pushed under the hollow of the back and then worked downwards. Before he is moved, the legs should be tied together and a blanket should be passed beneath him. Poles are then attached to the blanket and he is transferred to a stretcher in the manner described for fractured spine.

As the urethra may have been ruptured, he should be warned not to try to pass urine until he has been seen by a medical officer. Urine from a torn urethra may flow into the tissues and give rise to infection and inflammation.

155. Fracture of the lower jaw.—Besides the usual signs of fracture, the following are often present : (*a*) inability to

speak or to move the jaw freely ; (*b*) irregularity of the teeth, noticeable on looking into the mouth or on passing the finger along them ; (*c*) bleeding from the gums ; and (*d*) excessive flow of saliva. The special danger with these injuries is obstruction of the airway, either by the tongue falling back into the throat, or by teeth or blood clot. When the fracture is caused by a bullet or a piece of shell or bomb, there will probably be hæmorrhage from the tongue, which is likely to be wounded at the same time.

Treatment.—If breathing is difficult, grasp the tongue with a dry cloth or handkerchief and pull it forwards. Clear the mouth of blood clot or other obstruction, and place the patient in such a position that his face points towards the ground.

If conscious and able to do so, he may sit down leaning forwards. If he is evacuated as a walking casualty, he should rest his hands on the shoulders of the man in front, so that he is guided but can keep his head down. If he is weak or unconscious, he should be laid face downwards with his head supported in the crook of his arm ; or his head can project over the canvas end of the stretcher, with the forehead supported by bandages or slings running between the stretcher handles. The stretcher should be carried feet first, so that the rear stretcher-bearer can constantly observe the patient's condition.

When the jaw is broken on both sides, and the tongue has thus lost its normal support, no bandage should be applied, for it might increase the displacement of the fragments. In other cases a barrel bandage will be useful (para. 113).

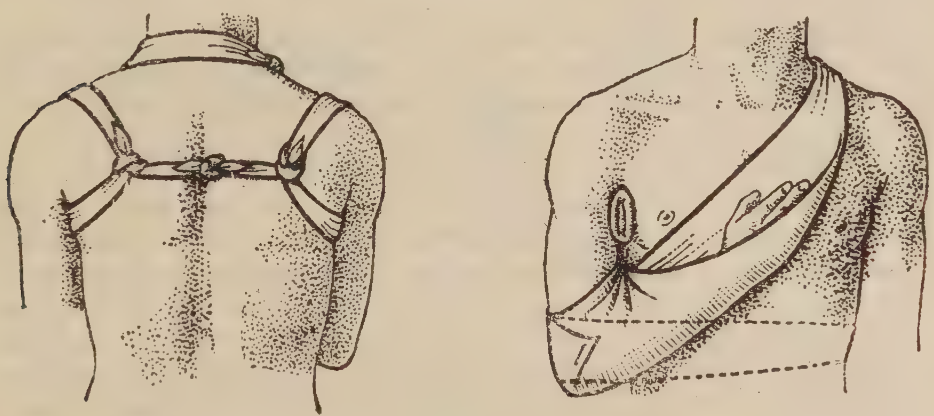
When bleeding is very severe the common carotid artery may have to be compressed (para. 131) until a medical officer can ligature the bleeding vessel or clip it with forceps.

156. Fracture of the ribs.—When a rib is broken, the patient complains of severe pain on taking a long breath, and grating (crepitus) may be detected on placing a hand over the injured part. In addition to these signs, when the lung is injured, as is often the case, blood may be coughed up.

Treatment.—If no blood is coughed up, and if there is no other reason to think that the lung is injured, support the ribs by passing two broad-fold bandages firmly round the chest. The centre of one bandage should be immediately above, and the centre of the other directly below, the seat of fracture, the upper half of the lower bandage overlapping the lower half of the upper bandage. The lower bandage should be applied first : the patient is asked to breathe out, and the bandage is then tied on the side of the body opposite to the injury, with the knots slightly to the front. Apply the greater arm-sling on the injured side.

When the ribs are crushed in, or the patient coughs up blood, do not apply bandages to the chest ; for great damage might be done by pushing the fragments still further into the lung. In this case lay the patient down, slightly inclined towards the injured side ; loosen all clothing and apply the greater arm-sling. The patient must reach hospital as soon as possible.

157. Fracture of the clavicle.—This is caused either by a fall on the shoulder or outstretched hand, or by direct violence applied to the collar-bone itself. The arm on the injured side is helpless ; the patient usually supports it at the elbow with his other hand, and the head is inclined towards the injured side. On examination, a deformity in the line of the clavicle will at once be apparent, and to this point the patient will refer most of the pain from which he suffers.



a b

FIG. 57.—TREATMENT OF FRACTURED CLAVICLE : (*a*) WITH THREE TRIANGULAR BANDAGES ; (*b*) WITH TWO.

Treatment.—While the patient, or an assistant, supports the arm, pass a narrow-fold bandage round each armpit, with the centre (padded if possible) in front. Tie each bandage on the back of the shoulder, leaving one end of the knot longer than the other. Then pull the two longer ends towards one another —thus drawing back the shoulders—and tie them together (Fig. 57a). The hand may be supported by thrusting it into the buttoned jacket, or with a greater arm-sling. If a sling is applied, the lower end, which is brought up in front of the forearm, should be pushed between the upper arm and the chest wall before being tied, as shown in Figs. 39 (modified greater arm-sling) and Fig. 57b. If it were brought up in front in the usual way it would press on the injured bone.

Another method of treatment, using only two triangular bandages, is to put a pad in the armpit, apply a sling in the

way just described, and fix the arm firmly to the side with a narrow-fold as indicated by the dotted lines in Fig. 57b.

158. Fractures at the shoulder joint.—The patient has pain, tenderness and swelling over the shoulder, and cannot raise his arm above the level of the shoulder. It is sometimes hard to say what bone is broken ; it may be the outer end of the clavicle, or part of the scapula, or the upper end of the humerus ; or there may be some doubt whether the shoulder joint is dislocated.

Treatment.—Fix the arm to the side with a broad-fold ; the centre of the bandage is placed over the outer and upper part of the arm, and the ends are carried round the body and tied over a pad in the opposite armpit or (better) over the opposite shoulder as shown in the top picture of Fig. 58. Apply the lesser arm-sling.

159. Fracture of the shaft of the humerus.—The usual signs of fracture are present. The chief danger is damage to the axillary or brachial artery or to a nerve which passes round the bone.

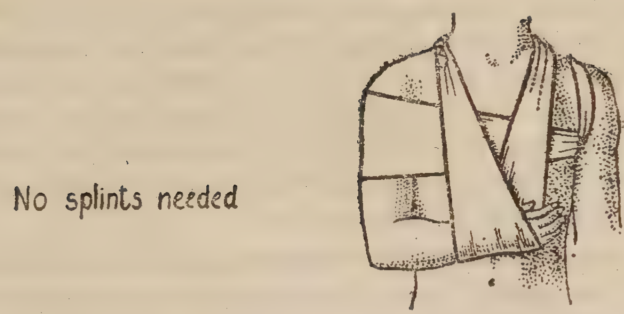
Treatment.—The patient sits, or if necessary lies down, and his arm is freed from any thick clothing. An assistant, or the patient himself, supports the arm with the elbow bent at a right-angle, and four padded splints are applied to the front, back and two sides as shown in Fig. 58. The shortest splint is on the inside, and none of them must press into the armpit or the bent forearm. The splints are secured with two narrow-folds, one above and one below the fracture, the knots being tied on the outer side. The weight of the arm tends to pull the lower broken fragment downwards away from the upper fragment, which is a good thing. It would be a mistake, therefore, to support the elbow with a greater arm-sling. The lesser arm-sling, supporting the wrist, is what is wanted.

When the splints, bandages and sling have been applied, feel the pulse at the wrist. If no pulsation can be detected, the bandages are too tight and must be loosened till the pulse can easily be felt.

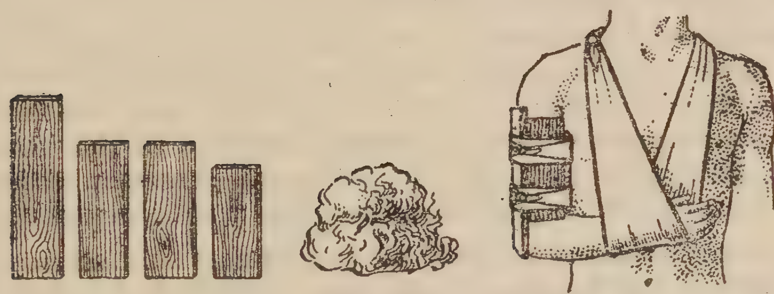
If only two splints are to be found, put one behind the arm and one in front. If no splint whatever can be improvised, fix the arm to the body with two broad-folds.

160. Fracture of the humerus near the elbow joint.—When the bone is fractured where it lies inside the joint there is likely to be much swelling and it may be difficult to bend the elbow.

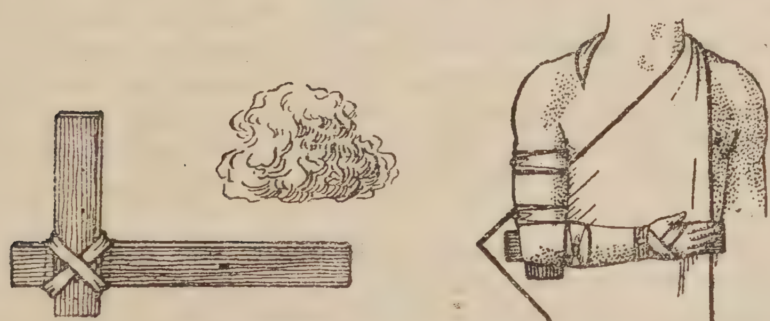
Treatment.—The patient or an assistant holds the arm, bent at a right-angle, while two splints are fixed together in an L shape as illustrated in Fig. 58. One should be long enough



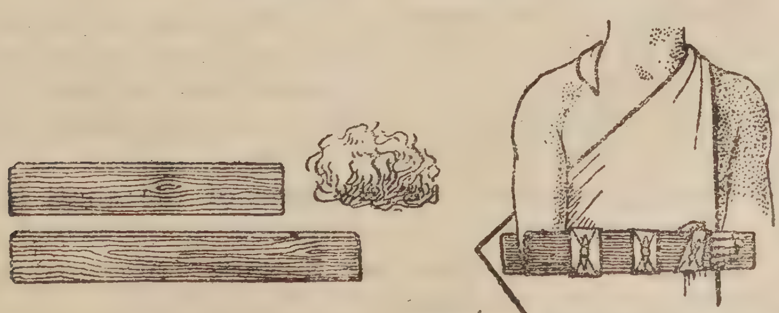
BANDAGES ONLY FOR FRACTURE OF UPPER HUMERUS



SPLINTS AND PADDING FOR FRACTURE OF MIDDLE HUMERUS



"L" SPLINT AND PADDING FOR FRACTURE OF LOWER HUMERUS



SPLINTS AND PADDING FOR FRACTURE OF RADIUS AND ULNA

FIG. 58.—TREATMENT OF FRACTURES OF THE ARM.

to reach from the armpit to below the elbow, while the other reaches from beyond the elbow to the tips of the fingers. After they have been fixed and padded, they are applied on the side of the limb which is least swollen or injured, and are secured by four narrow-folds—two round the arm, one round the upper part of the forearm, and one round the wrist. The greater arm-sling is then put on.

161. Fracture of the olecranon.—The olecranon process is the upper end of the ulna, and it forms the point of the elbow. Occasionally the tip of the bone is broken off and pulled upwards by the muscles attached to it ; a gap can be felt and the patient cannot straighten his elbow.

Treatment.—The object is to keep the two parts of the broken bone close together, and this is done by preventing the elbow from bending. A splint reaching from the middle of the upper arm down to the wrist is secured to the front of the arm with a couple of narrow-folds. Another bandage holds the arm to the body, with the palm turned inwards.

162. Fractures of the shaft of the radius and/or ulna.—One or both of the forearm bones may be broken.

Treatment.—The elbow is bent at a right-angle, with the palm towards the body. Two splints are used, one longer than the other (Fig. 58). The longer, reaching from beyond the finger-tips to beyond the elbow, is placed along the palm of the hand and up the forearm ; while the shorter one reaches only down to the knuckles. They are secured with three narrow-folds—one above the fracture, one below, and one round the hand below the thumb. The greater arm-sling is then applied.

Press slightly on the finger-nails below the splint. If the colour does not return instantly when pressure is released, the bandages are too tight. If in doubt, compare the return of colour in the injured and the uninjured hands.

163. Fracture at the wrist.—The lower end of the radius is often broken by a fall on the outstretched hand, or in turning the starting-handle of a vehicle. Sometimes the only signs are tenderness and swelling, but there may be tilting of the wrist or other obvious alteration in shape.

Treatment.—As described for fractures of the shaft (para. 162).

164. Fracture of the hand or fingers.—Various bones may be broken, *e.g.* by machinery.

Treatment.—A splint about eight inches long by three or four inches wide is put in the palm of the hand and held in place with a figure-of-8 bandage. A sling supports the hand.

Where there is bleeding from the palm it will probably be better to put a dressing and pad in the palm and apply a bandage over the half-closed fist (Fig. 51, page 95).

165. Fracture of the femur.—When the femur is broken the foot lies on its outer side, and the patient cannot lift it from the ground. Sometimes the leg is obviously shorter than its fellow, because the two parts of the bone are overlapping.

The injury is always serious, even if the skin is unbroken and there is no hæmorrhage. The patient may die of shock if he is moved far without proper support for the leg. Uncontrolled movement of the broken ends of this large bone will cause great pain, and much loss of blood and fluid into the tissues or externally.

Treatment depends on the resources available.

1. The best means of making the patient comfortable during his journey to hospital is the Thomas splint. Bandages attached to the splint exert a steady pull on the foot, and this tends to straighten the leg and prevent movement and overlapping of the two parts of the femur. The application of the splint is described in detail in the next chapter.

The Thomas splint should not be used if there is a buttock wound against which the ring of the splint will press.

2. If a Thomas splint is not available or should not be used, the leg can be extended and supported as follows :—

The foot is fixed with a clove-hitch halter (Fig. 62, page 120), or with a Millbank boot-clip, to the nearest handle of the stretcher, and the foot end of the stretcher is then slowly raised about 2 feet. The weight of the patient's body will exert a pull away from the foot, and will thus extend and straighten the leg, drawing the upper fragment of the femur away from the lower fragment. When this pull is fully exerted, the trunk should be fixed to the head end of the stretcher either (*a*) with a broad bandage passed between the thighs (avoiding the scrotum), or (*b*) by placing a bandage beneath the shoulders and bringing the ends up over the armpits and fastening them to the handles at the head end of the stretcher. The foot of the stretcher can now be lowered and small splints can be applied to the front and back of the thigh over the site of fracture. Finally padding is placed between the legs and they are tied together at the knee, below the knee, and with a figure-of-8 bandage at the ankle. The sound leg acts as a splint to the other (Fig. 59).

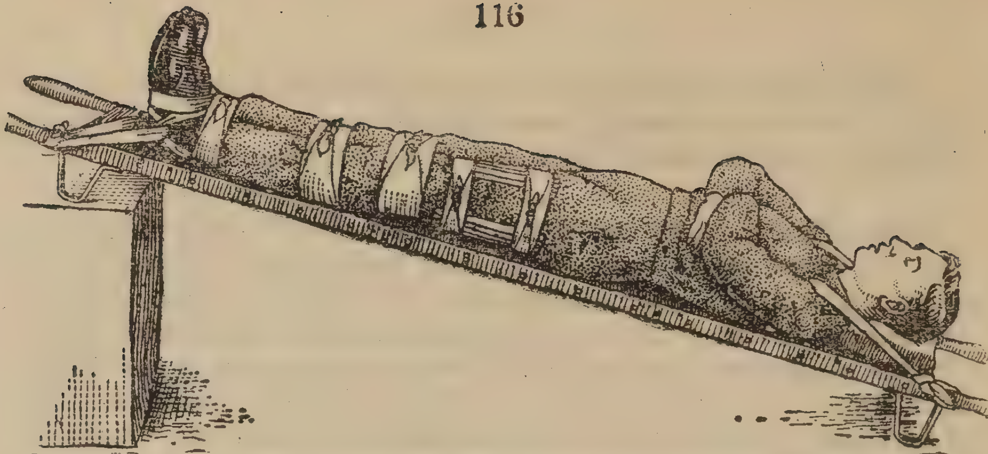


FIG. 59.—FRACTURED FEMUR. A METHOD OF OBTAINING EXTENSION WHEN A THOMAS SPLINT IS NOT AVAILABLE OR CANNOT BE USED.

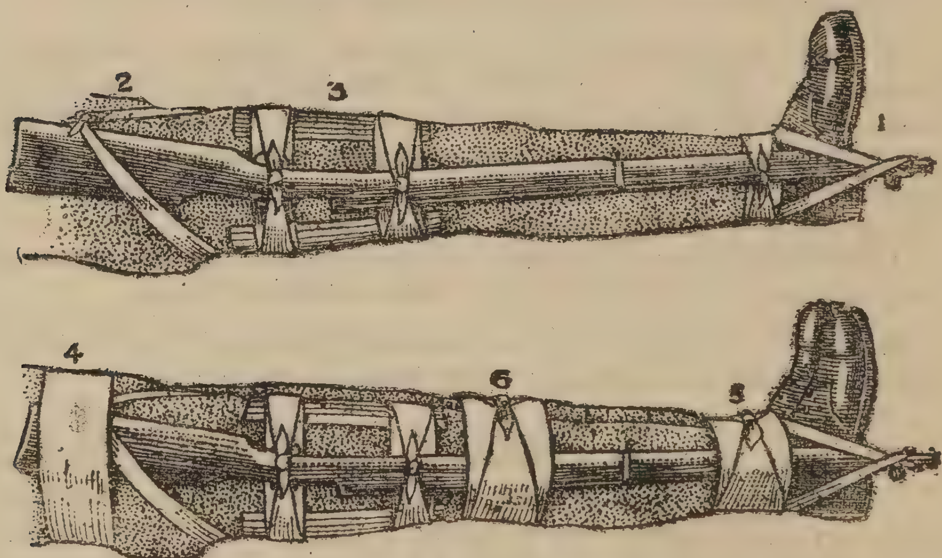


FIG. 60.—RIFLE USED AS SPLINT FOR FRACTURED FEMUR.

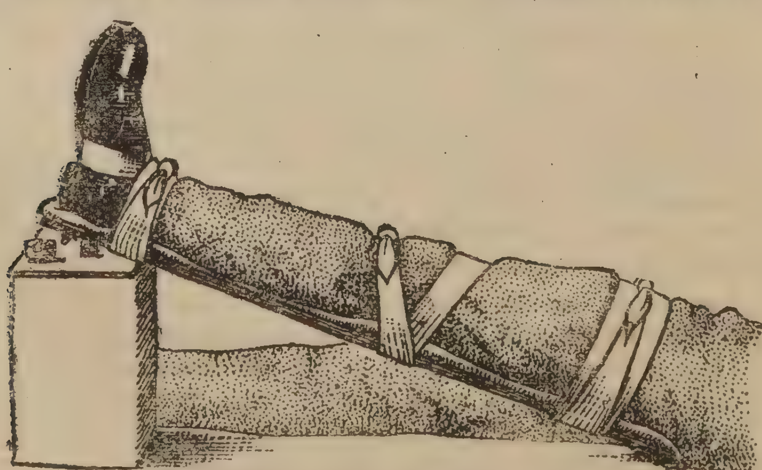


FIG. 61.—TREATMENT OF FRACTURED PATELLA.

3. If neither of the above methods can be adopted it is possible to make use of a rifle as shown in Fig. 60. With the patient lying flat on his back, the injured leg is gradually brought into line with the sound leg; this is done by grasping the ankle and pulling gently downwards, never using enough strength to cause severe pain. The rifle is then placed along the leg, with the barrel projecting 3 or 4 inches below the foot and with padding between it and the leg. Bandage No. 1 in the Figure is passed round the ankle (inside the splint) and over the rifle sight and is tied over the barrel. That fixes the foot. Extension of the leg is maintained by bandage No. 2 which has its centre in the crutch and runs through the sling swivel on the stock of the rifle. With these two bandages safely in position the leg cannot be further shortened.

Small splints are then applied (No. 3 in Fig. 60) over the fracture, the bandages being tied off over the rifle. Finally broad-folds go round the body (No. 4), the ankles (No. 5), and the knees (No. 6).

166. Fracture of the patella.—The knee-cap is the bone most often broken by muscular contraction. When it is fractured the muscle at the front of the thigh tends to pull the upper fragment away from the lower one, as was illustrated in Fig. 53, page 102.

Treatment.—The first object of treatment is to relax the muscle by straightening the knee and bending the hip. A straight splint extending from the buttock to the heel is padded and fixed to the back of the leg with a bandage round the thigh and a figure-of-8 round the ankle (Fig. 61). Alternatively a Thomas splint can be applied.

The foot and the shoulders are then raised; this flexes the hip. The centre of a narrow-fold is placed above the patella, and the patella is drawn downwards as far as possible; the ends of the bandage are crossed over the splint behind the knee, and tied off in front below the knee. The leg and shoulders should not be lowered during evacuation to hospital.

167. Fracture of the tibia and fibula.—The tibia or shin-bone lies just under the skin, and when it is broken the ends often protrude. If this has not already happened, it is most important to see that it does *not* happen—either through sudden movements by the patient, or through careless handling by the first-aider. The limb must be steadied while splints or bandages are being put on, and the splint must make the leg perfectly safe for transport.

Treatment.—A Thomas splint, carefully applied, is the best means of treating fractures of the upper two-thirds. But improvised splints will be satisfactory provided they are

strong enough ; and several thin sticks, for example, will give as good support as one thick one—indeed better. If possible there should be a splint on the inside of the leg as well as on the outside ; but the outside is more important. A splint must never be put on the front of the leg, where the bone lies under the skin.

The length of the splints should be such as to prevent movement in the joint above the fracture and in the joint below, and they should be padded. The first bandage secures them to the foot, and the second to the thigh above the knee. A third and fourth are placed above and below—but *not* over—the site of fracture, if this is in the shaft of the bone. A fifth goes round the splint and over the opposite knee, thus tying the legs together, and a sixth round the splint and the two ankles.

168. Fractures of the foot.—The boot often serves as an effective splint. When it has to be removed, the leather may have to be cut to avoid pain. A short flat splint, reaching from the heel to the toes and generously padded, gives support. The centre of a narrow-fold is placed under the splint, and the ends are crossed over the instep and carried backwards round the leg above the heel. They are then taken back over the instep and tied over the splint.

CHAPTER 24

THE THOMAS SPLINT

169. The Thomas leg-splint consists of an oval iron ring, united obliquely to another length of round iron which forms the side bars and end of the splint ; the ring is padded and covered with leather. The same splint can be applied to either leg.

In the field it is usually carried by threading a closed stretcher through the ring, and tying the side bars to the stretcher. To keep it in good condition the bars are lightly smeared with soft paraffin, and the leather covering of the ring is occasionally cleaned and softened with saddle-soap.

The Thomas splint is the best first-aid splint :—

(*a*) For all fractures of the femur, unless there is a large wound in the upper part of the thigh or buttock which would interfere with the fitting of the ring.

(*b*) For all fractures about the knee (including the patella) and fractures of the upper two-thirds of the tibia.

(*c*) For cases with extensive wounds of the fleshy part of the thigh or leg.

The following paragraphs describe the method of application in a case of fractured femur, and this method may have to be modified for other injuries.

170. Personnel and apparatus required.—Three bearers are needed : No. 1 is responsible for the application ; Nos. 2 and 3 assist him.

In practising the application, the patient may be splinted lying on a stretcher, which should rest on trestles ; but an actual casualty should be splinted where he lies, unless it is absolutely necessary to remove him to a place of shelter. Application of the Thomas splint should be practised in the dark and wearing anti-gas respirators.

The apparatus necessary is :—

- (*a*) Thomas splint. (As this splint is applied over the trousers in first-aid treatment, the ring must be a large one).
- (*b*) Stretcher suspension bar.
- (*c*) Reversible stirrup (Sinclair's).
- (*d*) Millbank boot-clip ; or, if this is not available, 3 yards of flannelette bandage to form the clove hitch.
- (*e*) Five flannelette bandage slings and five safety-pins.
- (*f*) Five triangular bandages.
- (*g*) Some loose-woven bandages and wool.
- (*h*) Two pieces of Cramer wire about 8 inches by 6 inches. (Cramer wire is a stiff network which can be cut and bent.)

To form the slings mentioned above, five pieces of flannelette bandage approximately 30-36 inches long are taken and folded into two. The loop ends are pinned over the inner bar of the splint, rolled up and secured in position by short ties of loose-woven bandage.

171. Application of the splint (Fig. 63).—In applying the splint and getting the patient ready for evacuation there are twelve stages.

1. Preparing the Stretcher.—The stretcher is prepared in the usual way, with blankets in position, and the patient is moved on to it.

2. Extending the Limb.—No. 2 bearer stands at the foot of the stretcher, facing the patient and opposite the injured limb. Grasping the heel of the boot with his right hand, and the toe with his left, keeping his arms straight, he exerts a steady pull, thereby producing the necessary extension. This pull (traction) on the foot by No. 2 bearer must not be relaxed for a second until the splint and extensions have been fixed in position (Stage 5).

No. 3 supports the limb at the site of the fracture, and continues to do so till the dressing and Cramer splinting have been applied (Stage 7).

3. Maintaining Extension.—A clip or bandage must now be fixed to the foot so that the foot can be secured to the splint. This is done by No. 1 bearer and there are two ways of doing it :—

(*a*) *Millbank clip.*—Take a Millbank clip and apply it to the waist of the sole, so that the points rest in the groove between the upper and the sole. The outer point should be 1½ inches nearer the toe than the inner point. (This will cause the toe to point slightly outwards when the side pieces of the clip rest on the splint bars.) Apply a piece of bandage 2 feet long to the outer end of each side piece of the clip.

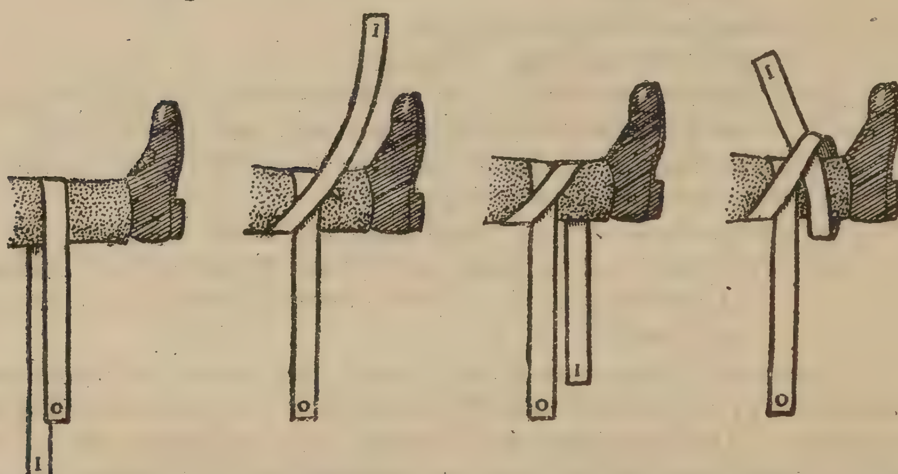
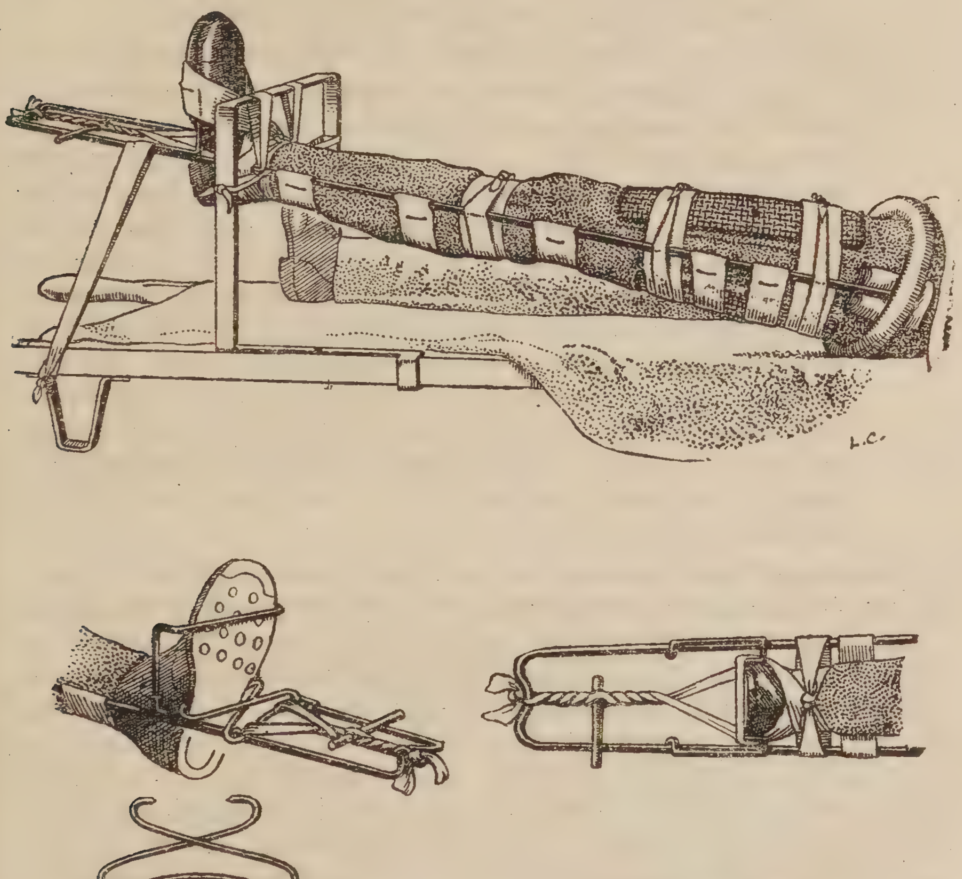


FIG. 62.—CLOVE-HITCH HALTER. I = INNER. O = OUTER.

(*b*) *Clove-hitch halter.*—To form the clove hitch, place the centre of a 9-foot flannel bandage across the leg and let the ends hang down (Fig. 62). Take the end on the inner side of the leg and bring it under and up the outer side. As it is brought up let it cross over the other end. Pass it round the leg again and thrust its free end through the loop formed as it passed up the first time. A clove hitch has been formed. Do not draw it tight, but slip the hitch down to a point above the ankle. Next pass the long end across the sole of the boot just in front of the heel and through the loops on the inner side from below. Draw tight. There is now an extension band on each side of the ankle.

4. Slipping on the Splint.—No. 1 bearer slips on the splint, No. 2 removing and reapplying his upper and lower hands alternately to allow the ring to be passed over the foot. The splint should be pushed up under the buttock until the ring rests against the tuber ischii in the buttock (Fig. 11, page 25). This bony process is intended to bear pressure. If the ring slips past it and rests against the groin it will not



EXTENSION USING MILLBANK CLIP

EXTENSION USING CLOVE HITCH

Fig. 63.—The Thomas Splint Applied.

only interfere with extension but may also hurt the testicles and other soft parts. The patient should feel that he is sitting on the ring.

When the splint has been placed in position the two side bars should be at the same level. If a Millbank clip has been used to secure the boot, its side pieces should be resting on the side bars of the splint.

5. Fixing the Leg.—No. 1 bearer ties the extension bands of the Millbank clip or clove hitch round the notched bar at the end of the splint as follows :—

The outer band is passed over and under the bar at the notch, drawn taut and held over to the opposite side. The inner band is passed in the reverse direction—that is, under and over the notched bar, crossing the first band at the notch and preventing its slipping. The two bands are finally tied off by a half bow.

An alternative method of fixing the extension bands :—

One band is passed outside its nearest bar, crosses to the other side and passes over the bar and is then brought down to the notch. The other band is dealt with similarly but passes under the bar on the opposite side. The bands are then tied tightly in a reef knot at the notch. The crossing of the bands forms a diamond. When it is necessary to further tighten the extension one of the loose ends of the bands is passed through the V formed at the top of the diamond where the two bands cross. By pulling on it a greatly increased extending force can be produced. It is tied to the other loose end. This method saves the necessity of finding the small piece of wood to form the Spanish windlass (Stage 9).

As soon as the extension bands have been tied, No. 2 bearer ceases to hold the foot and supports the lower end of the splint.

No. 1 bearer ties off the middle sling over the outer bar behind the knee, No. 3 bearer keeping the knee slightly bent. The slings behind the ankle and calf are also tied off, so that the leg is now supported in a shallow trough, with the long bars of the splint level with the centre of the leg. To prevent the leg rising off the splint, a narrow-fold is placed across the leg just below the knee ; the ends are carried down between the leg and the splint, crossed behind, brought up outside the bars and tied off on the front of the leg.

The lower limb is thus fixed in a position of extension, and it may be moved freely without causing pain to the patient or damage to the injured part. Once fixed in the splint, the limb must not be allowed to rest on the stretcher or ground. Until the end of the splint is fixed to the suspension bar, it must be supported by hand or rested on some article large enough to keep the leg clear of the stretcher.

6. Dressing the Wound.—The wound (if any) is exposed by cutting away the overlying portion of clothing, and a dressing is applied. (If there is much hæmorrhage, steps will have been taken to control it before splinting was begun).

7. Cramer Splinting and Bandages.—One piece of Cramer wire is placed behind the limb at the site of the fracture and secured by tying off the remaining two slings. The other piece is placed in front of the limb, care being taken to prevent the lower edge pressing on the patella. The dressing and splints are now kept firmly in position by two narrow-folds in the following manner :—

> The centre of each bandage is placed on the front of, and over the centre of, the Cramer splint. The ends are taken down between the limb and the side bars of the splint, crossed behind and then brought up on the outside of the bars and tied off in front of the limb.

There is now no further need for No. 3 bearer to support the limb at the site of fracture.

8. Stirrup and Figure-of-8.—The stirrup is sprung on to the splint so that the shaped part fits the sole of the boot, thus preventing movement of the foot sideways. A narrow-fold is then applied to form a figure-of-8. The centre of the bandage is placed under the sole of the boot. The ends are brought forward, crossed, taken down behind the ankle, crossed again, brought up outside the bars and tied off in front of the limb.

9. Spanish Windlass.—The extension bands are retied, if necessary, and a small piece of wood is inserted to twist up, and so tighten, the bands as required.

10. Padding the Ring.—For first-aid a large ring is required, because allowance must be made for possible swelling of the thigh. To fill the gap, two pads are needed, one on the outer side and one in front. They should be fairly firm—*e.g.* a rolled-up flannel bandage. The object is not only to prevent sideways movement of the limb inside the ring, but also to prevent the ring slipping inwards or backwards off the tuber ischii.

11. Suspension Bar.—This bar is now fitted to the stretcher, grips away from the runners, with its horizontal part a hand's breadth in front of the foot. The splint is then slung by two long ties, a hand's breadth below the horizontal bar. To prevent movement from side to side, the ends of these ties are secured round the uprights of the suspension bar. To prevent vertical movements of the splint, a narrow-fold is passed round the outer bar of the splint below the foot and tied to the runner of the stretcher.

Note.—For the purpose of transport, it may be advisable to place pads of wool at the sides of the knee and ankles, and bandage over the pads, limb and side bars.

12. WARMTH.—The blankets are adjusted as shown in Fig. 48, page 87, and the patient is ready for removal. (For work in the dark, in pinning the blankets, it is advisable to include a small piece of bandage or other white material under each pin).

172. How a Thomas splint acts.—The ring pressing against the innominate bone (tuber ischii) fixes the upper fragment of the fractured bone. As the side bars and end of the splint are in one rigid piece, it follows that traction on the foot—maintained through the extension bands which attach the foot to the end of the splint—will pull the lower fragment away from the upper fragment and so make further shortening of the limb impossible.

In first-aid no attempt is made to "reduce" the fracture completely and thus restore the normal length of the leg. When the femur is broken, a very strong pull may be required to overcome entirely the muscular contraction which causes the two broken ends to overlap. First-aid does not seek to do this. Its object is merely to prevent movement of the fragments and so stop the sharp ends from doing further damage to the tissues (including blood-vessels and nerves) and from piercing the skin if they have not already done so. When the patient reaches hospital the limb will be fully extended and the two parts of the broken bone will be brought into the best position for healing.

Too strong a pull on the foot through a clove-hitch halter—or even through a Millbank clip, if continued long enough—is liable to interfere with the circulation in the foot and thus cause ulceration and perhaps gangrene. Traction on a tight boot has the same effect; so *make sure that the boot-laces are loose.*

CHAPTER 25

SPRAINS AND DISLOCATIONS

173. Sprains and strains.—When a joint is wrenched or twisted, the ligaments that hold the bones together may be stretched or torn. Stretching of the ligaments is generally called a *strain*, while tearing of the ligaments is called a *sprain.*

It is not always easy to tell a severe sprain from a fracture. For example, the usual result of "going over" the ankle on the inside is a sprain—the tearing of a ligament at the side of

the joint (Fig. 64a and b). But instead of tearing, the ligament may pull a fragment of bone off the end of the tibia (c), and subsequent swelling of the tissues may make it impossible to detect this small fracture without the aid of X-rays.

A more violent wrench in the same direction will break the shaft of the fibula as well as the end of the tibia (d).

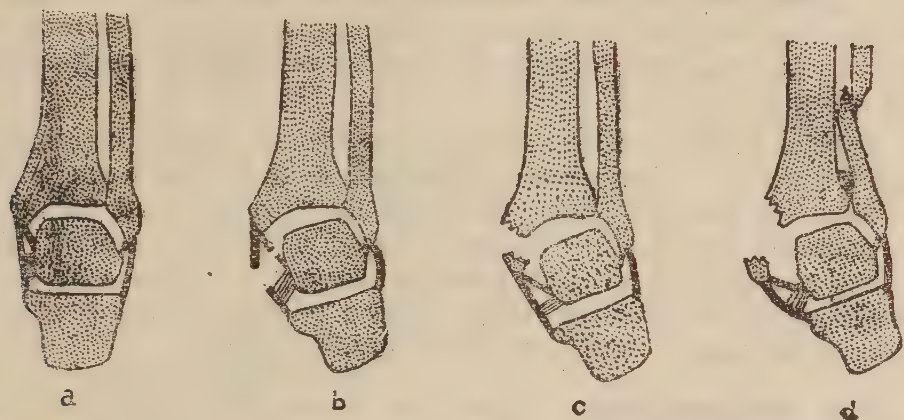


FIG. 64.—(*a*) SECTION THROUGH NORMAL ANKLE JOINT. (*b*) LIGAMENTS TORN ON INNER SIDE (SPRAIN). (*c*) POINT OF TIBIA PULLED OFF. (*d*) FRACTURE OF BOTH TIBIA AND FIBULA.

174. Signs and symptoms of sprain.—The patient may hear a click as the ligament breaks. Immediately afterwards there is acute pain, made worse by putting the damaged ligament on the stretch. It may be difficult to move the joint freely. Though nothing abnormal is seen just after the accident, swelling soon develops at the site of injury, with increase of fluid in the joint itself (*synovitis*). Bruising appears later because of the escape of blood from torn blood-vessels.

175. Treatment of sprains.—Any sprained joint needs (*a*) support, and (*b*) rest.

Ankle.—With a sprained ankle (the most common form of sprain), the patient can often walk a short distance once the first pain of the injury has worn off—usually in about five minutes. The socket of the ankle joint is so deep that this does no harm provided that he takes care not to twist his foot again. If much walking will be necessary, his boot should be put on again before swelling makes this impossible. A firm figure-of-8 bandage will give welcome support. If pain is severe a splint should be applied.

A form of treatment useful soon after the accident is to dip the foot alternately into cold water and very hot water, 30 seconds in each, continuing for a quarter of an hour or more.

The hot water must be frequently replenished so that it is always about as hot as the patient can bear. Hot or cold fomentations also give some relief.

Otherwise treatment consists in putting the part at rest and supporting it by a bandage applied firmly over plenty of cotton-wool. Massage to reduce the swelling and disperse extravasated blood should be started at the earliest opportunity. As soon as the pain is bearable, the patient may be encouraged to walk again, with a bandage (preferably elastic) supporting his ankle.

Knee.—Twists and sprains of the knee are common, especially at football. The joint may be locked so that it will not bend.

With the patient lying down, the leg is raised and the knee surrounded with plenty of cotton-wool. This is covered with a firm bandage, then with a second layer of cotton-wool, and finally with another bandage. There will be no harm in the patient walking a little way if he is able to do so.

176. Dislocations.—When the bones of a joint are put out of their usual position they are said to be *dislocated.* Dislocation is always associated with tearing or stretching of ligaments.

Certain joints are much more liable to dislocation than others. Because of their wide range of movement, ball-and-socket joints are more often dislocated than hinge joints ; for example, dislocation of the shoulder is common compared with dislocation of the elbow. Again, joints like the shoulder, which depend largely on the support of surrounding muscles, are more often dislocated than joints like the hip in which the shape of the bones themselves gives the main support.

177. Signs of dislocation.—Dislocation causes pain at the joint. The visible signs of the injury are :—

(*a*) *Deformity—e.g.* a limb differs in shape from the opposite limb (Fig. 65).
(*b*) *Restriction of movement* at the joint.
(*c*) *Swelling* at the joint, partly through injury of the soft tissues but often through displacement of the bone.

A dislocation may be distinguished from a fracture because :—

(*a*) It always occurs in a joint.
(*b*) Instead of abnormal mobility, there is loss of movement.
(*c*) If the end of the bone can be felt, it is smooth and rounded, whereas in a fracture it is sharp and angular.
(*d*) There is no grating.

It must be remembered, however, that a dislocation may be combined with a fracture—for example, fracture of the humerus with dislocation of the shoulder. Also, dislocation may be open (compound): that is, the displaced end of the bone may protrude through the skin.

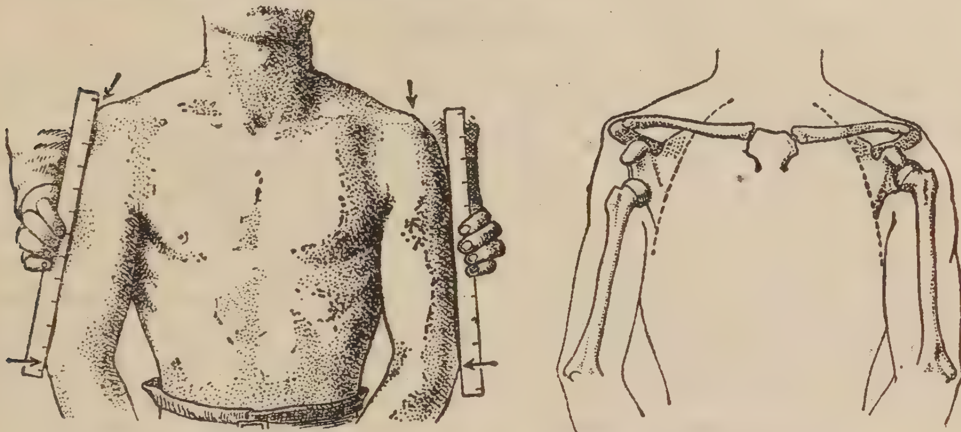


FIG. 65.—DISLOCATION OF RIGHT SHOULDER.

The normal rounded appearance has been lost on that side, and a ruler will touch both the point of the elbow and the point of the shoulder.

178. Treatment of dislocations.—The important points are :—

No inexperienced person should try to reduce a dislocation. Unskilled attempts may do serious damage.

First-aid treatment consists in the application of a sling, or of pads and bandages, so that the limb is kept at rest until the patient can reach hospital, or a medical officer arrives. A towel wrung out of cold water will lessen pain.

Dislocations should be reduced soon. There should therefore be the least possible delay before the patient is seen by a medical officer.

Simple (closed) dislocations are usually reduced by manipulation or extension. If there is much muscular resistance, a general anæsthetic may be needed. After reduction, the part is supported with bandages to keep the joint at rest until the injured ligaments have healed, and also to prevent the joint from being dislocated again. At a later stage massage is useful.

Dislocation of the jaw.—The lower jaw is sometimes dislocated in yawning or by a blow on the chin. Reduction should be left to a medical or dental officer. Meanwhile dentures (if worn) should be removed, but no other treatment is required.

CHAPTER 26

BURNS

179. A burn is a kind of wound. But instead of being caused by violence it is usually caused by heat.

Some might say that a burn is always caused by heat, or it would not be a burn. But doctors use the word to cover the effects not only of heat but also of extreme cold, and of electricity, and of certain chemicals, all of which damage living tissue in much the same way. In this sense, burns include scalds from superheated steam, charring from an electric current, destruction by a corrosive acid, and even the results of frostbite. Certainly these are not exactly alike : the tissues may be, so to speak, boiled or roasted or pickled or frozen—either partly or completely, either fast or slow. But the result is always death for some of the cells, and a risk of infection by germs where the body's defences have broken down.

180. Burns caused by heat.—The severity of the burn naturally depends on how great the heat is, and how long the tissues are exposed to it. In slight cases there is nothing more than a redness of the skin, which soon disappears. With more serious burns, blisters form ; and when the damage has gone deeper the whole of the skin and some of the underlying tissues are destroyed.

Most of the deaths from burns are caused by ***shock***. The amount of shock depends mainly on how much skin is damaged; and for this reason redness of the skin over a large area is more dangerous to life than burning down to the bone over a small area. It will usually be found that burns extend a good deal further than at first appears.

*Treatment.**—In treating any serious wound two things have to be done :—

(*a*) Cover the wound with a sterile dressing to keep out germs.

(*b*) Treat for shock.

This holds good for burns, except that the order is better reversed. Consider the shock first, and then the burnt skin.

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* Rescue from fires, and methods of extinguishing flames, are described in Appendix I.

To minimize shock, the patient is kept lying down and must be guarded from chill. To relieve pain, aspirin is useful ; and in severe cases morphine is invaluable. Drinks, such as plenty of hot sweet tea, may be comforting and will help to prevent collapse from secondary shock later. Gentleness and reassurance are essential parts of treatment.

To put on a dressing, the burn must be laid bare ; but this should be done with the least possible disturbance ; clothes must not be dragged over injured parts (which the heat may have rendered free from germs) but can be cut away where necessary, not exposing the patient to cold. No attempt should be made to remove pieces of cloth which have stuck to the burnt flesh.

Various first-aid remedies can be applied to the burn ; but if no special preparation has been issued—and is available—for the purpose, the burn should be treated exactly like any other wound, and covered with a dry field dressing or larger pieces of sterile gauze.

If no suitable dressing is to hand, a burnt limb can be placed in a bath or basin of warm water containing bicarbonate of soda or washing soda (say, a heaped tablespoonful to the gallon), which temporarily relieves the pain : on removal it is at once covered with a sterile dressing, without being dried.

In the absence of a medical officer, there must be no delay in getting any badly burnt person into hospital.

181. Burns caused by electricity.—Electric shocks, and lightning, often leave the victim unconscious, with little or no breathing. He may seem to be dead ; and the first step—after rescuing him, if necessary, from the electric current—is to revive him as described in para. 204. When that has been done, he is treated as though his burns were caused by heat. Sometimes the tissues are deeply charred.

182. Burns caused by acids and alkalis.—Before treating a burn due to heat, it is obviously necessary to remove the cause : if the clothes are still burning the flames must be put out. In the same way, before treating a burn caused by a strong acid (*e.g.* nitric acid, sulphuric acid, hydrochloric acid) or a strong alkali (quicklime, caustic potash, caustic soda, ammonia), the burning process must be stopped. This is done first by washing the chemical away—by flooding the skin immediately with water—and secondly by neutralizing any chemical that remains. This corresponds to putting out the fire.

An acid is neutralized, or made inactive and harmless, by mixing it with an alkali ; likewise an alkali is neutralized by mixing it with an acid. Naturally, strong acids and alkalis

are not employed for this purpose, since they too would harm the burnt flesh. Suitable ones are :—

For acid burns.—Bicarbonate of soda, or washing soda (one dessertspoonful per pint of water); or magnesia or dilute ammonia.

For alkali burns.—Vinegar and water (equal parts); citric acid solution; lemon juice or lime juice. (Immediate application of 5 per cent. ammonium chloride has proved useful in preventing or mitigating burns by caustic soda or caustic potash. The burn should be irrigated for a few minutes with this solution, which is then washed away. It should not be soaked in the solution, or kept wet with it.)

As soon as the chemical has been washed away or made harmless, the burn itself is treated like any other burn—paying attention, as usual, to shock.

Internal burns caused by swallowing strong acids and alkalis will be discussed in para. 216, and corrosive burns of the eyes in para. 228.

183. Burns caused by phosphorus.—Incendiary bombs often contain white phosphorus, or sticky mixtures of phosphorus with other substances such as rubber. Phosphorus is a solid, which catches light when exposed to air; and even when extinguished it continues to damage any living tissues in contact with it.

Before a phosphorus burn is treated, the patient must be saved from further burning. This is done (*a*) by flooding the affected part with water or by covering it with wet dressings, and (*b*) by removing all particles of phosphorus at the earliest opportunity, neutralizing them if possible with a chemical solution provided specially for the purpose. The burn can seldom be cleansed of phosphorus before the patient reaches an aid-post or hospital. Meanwhile it is essential to keep it thoroughly wet.

Shock is likely to be severe unless care is taken to prevent it

184. Burns caused by blister-gas.—Mustard gas, lewisite, and several other gases burn the eyes and skin. First-aid measures are discussed in paras. 285 and 286.

185. Scalds.—A scald is a burn caused by very hot water or steam. Scalds of the skin require the same treatment as any other burns due to heat. Scalds of the mouth and throat may be seen in children, who sometimes drink from the spout of a kettle. The immediate dangers here are (*a*) death from

shock, and (*b*) death from swelling of the throat, which may close the airway and thus cause suffocation.

Cold wet cloths applied to the neck, from chin to chest, help to stop swelling. A doctor must see the patient as soon as possible ; for, if suffocation develops, an operation may be needed to save his life.

CHAPTER 27

LOSS OF CONSCIOUSNESS

186. Consciousness depends on the activity of the brain. In order to get rest, healthy people regularly allow their brains to become inactive for hours at a time : whenever they go to sleep they become more or less unconscious of their surroundings. That is normal and necessary. But the activity of the brain may also be reduced abnormally and excessively, and it may become impossible to wake the patient in any way. A person so deeply unconscious that he can neither see nor hear nor feel is said to be *insensible* or in a state of *coma*. Unconsciousness may last only a few seconds, or for many days.

In the chapter on hæmorrhage it was mentioned that loss of blood may eventually lead to unconsciousness : the brain becomes inactive because there is not enough blood to bring the oxygen it needs. In the same way failure of the supply of air to the lungs will deprive the brain of oxygen ; hence consciousness is soon lost in drowning, or when the nerve centres which control breathing are damaged by electric shock or by poisons. Again, carbon monoxide (coal-gas) poisoning will have the same effect by reducing the oxygen-carrying power of the blood. These accidents in which unconsciousness results from asphyxia or suffocation will be considered in the next chapter.

Even excluding asphyxia and hæmorrhage, however, there are a good many possible causes of reduction in the activity of the brain. They include :—

(*a*) Sudden failure in the supply of blood to the brain (*fainting ; primary shock*).

(*b*) Damage to the brain from a head injury (*concussion ; compression*).

(*c*) Damage to the brain from the bursting or blocking of a blood-vessel (*cerebral hæmorrhage* or *thrombosis*).

(*d*) Dulling of the brain by substances circulating in the blood in disease (*diabetic coma ; uræmia from kidney disease*).

(*e*) Dulling of the brain by narcotic drugs (*opium ; alcohol ; sleeping draughts*).

(*f*) Epilepsy.

(*g*) Heat-stroke.

Unconsciousness is also a feature of numerous diseases whose treatment forms no part of first-aid. It should be remembered, too, that in a hysterical attack the patient may *appear* to be unconscious.

187. Fainting.—Fainting or *syncope* is due to disturbance of the nervous control of the blood-vessels and heart. A painful injury, a fright, bad news, the sight of blood, or even the prick of a needle, may upset the nervous centres so much that the heart's action becomes ineffective ; too little blood then reaches the brain, and unconsciousness may follow. Fatigue, want of food, a hot stuffy atmosphere, or excessive smoking can make a healthy person faint, especially if he has to stand for a long time ; and temporary failure of the heart is also seen in people with heart disease and in patients who sit up or stand up while weak with illness.

Whatever the cause, the effect is the same. The patient turns giddy and pale ; he sees objects swimming round him ; if standing, he staggers and may fall. Breathing seems to cease, and the skin is usually cold and moist. The pulse is weak and often irregular.

Treatment.—An impending faint can often be prevented by sitting down and bending the head between the knees. Smelling-salts will help ; or half a teaspoonful of aromatic spirit of ammonia (sal volatile) in a little water.

If the patient actually faints, lay him down without raising his head. Keep his head lower than his feet. Loosen clothing round his neck and chest ; open the windows and disperse the bystanders so as to get plenty of fresh air. Cold water applied to the face and forehead is useful. When consciousness returns—but *not* before—give him sal volatile or hot tea or coffee.

188. Primary shock.—The collapse common immediately after an injury is similar to a faint, though often more prolonged and dangerous. It is caused, in the same way, by failure of nervous control of the blood-vessels and heart, and as a rule it will pass off if the patient is kept lying down and warm. (*See* paras. 122 and 253.)

189. Concussion of the brain.—A blow on the head may injure the brain even though the skull is undamaged. Similarly, the shock of a fall in the sitting or standing position can be transmitted to the brain through the spine and the skull. Head injuries of any kind are liable to cause stunning and unconsciousness (*concussion*), which may last only a few moments or for a week or more.

While unconscious, the patient usually lies on his back with muscles relaxed ; the eyes are closed and the eyeball may be insensitive to touch ; the pupils may be contracted or dilated, but as a rule are equal in size. The surface of the body is pale, cold and clammy, the breathing slow and shallow, the pulse fast and weak, and the temperature below normal. Fæces and urine may be passed unconsciously. Signs of fractured skull should be looked for (para. 153).

Treatment.—Even slight head injuries must be taken seriously at first. Until full consciousness returns, the patient is kept comfortably warm and quiet, lying down with his head low. (If he has trouble in breathing, the head should be turned on one side so that mucus and saliva can run out of the mouth and the tongue will not fall backwards.) Drinks, such as hot tea, may be given if he can swallow easily, but not otherwise : alcohol is harmful. If no medical officer is available the patient should go to hospital.

190. Compression of the brain.—Through injury or disease, something inside the skull may press on the brain—perhaps a collection of blood, or a piece of bone, or an abscess. Most often the signs appear some hours after an injury in a patient known to be suffering from concussion or a fractured skull. But it is by no means rare for people to recover temporarily from the first effects of a blow on the head—they may have been only dazed—and develop signs of compression as long as several hours later ; a blood-vessel inside the skull was ruptured by the accident, and blood has now escaped in such quantity that it is pressing on the brain.

The patient with compression becomes duller and duller, and may at first complain of headache. When the condition is severe, he lies on his back entirely unconscious. He is flushed and his breathing is slow and noisy, the lips and cheeks being puffed out with each breath. The pulse is full and slow at first but later becomes quick and irregular. The pupils are dilated, as in fatigue and fright, and may be unequal when the pressure is on only one side of the brain.

Treatment.—The first-aid treatment is the same as for concussion, except that, to reduce congestion (excess of blood) in the brain, the head may be raised slightly and an ice-bag

or cold wet cloths may be applied to the face and scalp. In hospital an operation will probably be undertaken to relieve the internal pressure.

191. Cerebral hæmorrhage.—Blood may escape from a blood-vessel in the brain (*cerebral hæmorrhage*) either because the walls of the vessel are weakened by disease, or because the blood-pressure is very high, or for both these reasons. The patient is usually elderly. Similar results follow blockage of a brain artery by a clot (*cerebral thrombosis*). Except that the onset is usually sudden, the signs are the same as those of cerebral compression—namely, in severe attacks, loss of consciousness, flushed face, slow and noisy respirations, and a slow pulse. In a slighter attack these signs may be absent.

The damage to the brain commonly paralyses the arm, leg or face on one side of the body (*hemiplegia*), and the paralysed part may be obviously floppy, even during unconsciousness. Illness of this kind is generally known as an apoplectic fit or a stroke.

Treatment.—The first-aid treatment is the same as for compression of the brain. If the tongue blocks the airway, keep the lower jaw forward by pressure behind the angle of the jaw.

192. Diabetic and uræmic coma.—In diabetes the amount of sugar in the blood occasionally rises because the body cannot burn it up properly. At the same time the burning up of other foodstuffs—particularly fats—is incomplete, and substances such as acetone, which are ordinarily broken up and excreted, may circulate in the blood in harmful quantities.

In certain circumstances, the brain may be poisoned by these substances so that the patient becomes unconscious, often deeply (*diabetic coma*). The patient can sometimes be roused but often is quite unconscious. His respiration is gasping, and the acetone gives a fruity odour to his breath (" like an orchard ").

A diabetic person being treated with insulin, which is the substance he needs to enable him to burn his sugar, may become unconscious if the dose of insulin is excessive.

Kidney disease may cause unconsciousness because the blood becomes full of poisonous waste-products which the kidneys have failed to excrete in the urine in the normal way.

Treatment.—In army personnel diabetic coma is of course very rare, since diabetes is likely to be noticed long before the stage of coma. Uræmia is seen mostly in hospital patients. All that can be done in first-aid for either condition is to see that breathing is not embarrassed by tight clothes or anything in the mouth. Keep the patient warm and comfortable and get him into hospital at once.

193. Drugs and alcohol.—Many drugs, such as opium and morphine, are used to relieve pain and give rest. Generally they do so by dulling the brain, and in large doses they cause deep unconsciousness or coma. Alcohol, in sufficient amount, has the same effect, and so have the narcotic drugs used for promoting sleep.

On finding a person unconscious it may be hard to say whether he is suffering from (*a*) a prolonged faint, (*b*) a head injury, (*c*) cerebral hæmorrhage, (*d*) diabetes, (*e*) uræmia, (*f*) drug-poisoning or (*g*) drunkenness. (Carbon monoxide poisoning and electric shock are more likely to be obvious from the circumstances). Fortunately, from the point of view of first-aid it is unimportant to distinguish the first five from one another. The treatment is essentially the same : keep the patient lying down, and warm ; send for a medical officer if one is available ; otherwise get the patient to hospital as quickly as you can. But poisoning by drugs and alcohol (like the other forms of poisoning described in Chapter 30) should be recognized and treated as soon as possible, in order to get rid of the poison.

A common mistake is to suppose that because a man's breath smells of drink his condition is necessarily caused by alcohol. It must be remembered that many people take whisky or brandy as a medicine when they are beginning to feel ill. Also a man may easily sustain a head injury after having a few drinks.

In true alcoholic coma the patient can almost always be roused, his temperature is always below normal, and his pupils are dilated. The pupils are also dilated in people who have taken an overdose of a sleeping draught or sleeping tablets, but in opium or morphine poisoning they are contracted to pin-points. In compression of the brain and in cerebral hæmorrhage they may be unequal.

Often the circumstances will point clearly to one or other condition ; but such patients must always be seen by a medical officer, and in doubtful cases no treatment should be undertaken in the meanwhile, beyond providing rest and warmth and seeing that the patient's air-passages are clear.

Treatment.—When poisoning by opium or alcohol or any other narcotic drug is recognized, the stomach should be washed out through a stomach-tube. Failing this, an emetic can be given if there is no difficulty in swallowing. (These methods will be described in Chap. 30.)

194. Epileptic fits.—Epilepsy is a common cause of temporary loss of consciousness. It is due to a local disturbance of nerve centres in the brain, and the attack may be so slight

as to pass unnoticed. In a typical fit, however, there are characteristic jerky movements (*convulsions*) of the limbs and sometimes the trunk, and three stages can be seen :—

Tonic stage.—The head is drawn back and the jaws are fixed. The hands are clenched and the legs extended. Respiration is impeded, and from being pale the face changes to a dusky or livid hue. The arms are flexed at the elbow, the hands are flexed at the wrists, and the fingers are tightly clenched into the palm. This stage lasts only a few seconds, to be followed by the

Clonic stage.—Muscular contractions give place to violent convulsive movements, and the limbs are violently jerked about. The muscles of the face are in constant movement. The eyes are rolled and the eyelids are opened and shut. At this stage the tongue may be bitten. The dusky colour gives place to pallor, and frothy bloodstained saliva escapes from the mouth. Fæces and urine may be passed. This stage lasts for two or three minutes and passes into

Coma.—The breathing is noisy and the face flushed ; the rigidity of the limbs passes off and unconsciousness is complete. If left alone, the patient sleeps, and later wakes to complain of headache and dullness.

Treatment.—During the attack the important thing is to make sure that the air-passages are kept clear : danger may arise, for example, from breakage of dentures (false teeth). The patient is kept lying down and the clothing of the neck and waist should be loosened. The movements of his limbs should be restrained to prevent him from hurting himself, and in hospital the bedside table should be moved out of his reach. To prevent biting of the tongue, the handle of a spoon or other suitable article, padded with a folded handkerchief or piece of bandage, may be held between the teeth ; but in fact this accident is uncommon.

Epileptic patients should be kept under close observation both during the attack and afterwards. While unconscious they are apt to turn over on their face and may be smothered in a soft pillow. After recovery they may not at first be responsible for their actions, and they must be watched until perfectly rational again. Moreover, they sometimes have several fits in succession.

A careful written note should be made on the behaviour of the patient during the fit. This may be very useful to the medical officer afterwards.

195. Hysterical fits.—Many fits are hysterical or "functional"—that is to say, they arise because the patient's emotions are temporarily out of control. Such fits have the following features :—

(*a*) The patient falls carefully and seldom hurts himself.

(*b*) There are no definite stages as in epilepsy.

(*c*) The arms are waved about and the patient talks or shouts during the fit.

(*d*) The patient is not wholly unconscious.

(*e*) There is no subsequent dullness or headache.

Treatment.—No active treatment is necessary. Keep the patient under observation.

196. Heat-stroke.—In very hot countries heat-stroke is a not uncommon cause of unconsciousness. Failure of the normal mechanism for cooling the body may lead to a very high temperature and rapid onset of coma. This condition will be further considered in Chapter 34.

197. Evidence of death.—If no heart-beat or pulse can be detected, nor any respiratory movement, there is a strong probability that the patient is dead. Stoppage of breathing can be demonstrated by holding a mirror before the mouth, or by placing a saucer of water on the chest ; if respiration continues, the mirror will be dimmed by the breath, and the surface of the water will move.

Where, however, the circumstances allow of any doubt—especially in cases of drowning, electrocution, poisoning and fits or seizures—it should if possible be left to a medical officer to decide whether there is still a chance of recovery ; and treatment should meanwhile continue.

A definite sign is *rigor mortis* or stiffening. Soon after death the body relaxes—though occasionally weapons or other articles are still tightly grasped by the hand. A few hours later the muscles begin to stiffen, starting with the neck and jaw ; at 12 to 18 hours the whole body will probably show this stiffening, but after about 36 hours the muscles will have relaxed again.

Rigor mortis may come on quickly and disappear quickly, as in hot climates and in bodies enfeebled by want, high fever or prolonged disease. Or it may be abnormally delayed.

CHAPTER 28

ASPHYXIA

198. A person suffering from shortage of oxygen is said to have *asphyxia.*

In a normal healthy person the blood picks up oxygen from air taken into the lungs by breathing. This system breaks down, and asphyxia follows; (*a*) if oxygen does not reach the lungs, (*b*) if the lungs are damaged, (*c*) if breathing ceases, or (*d*) if the blood cannot absorb oxygen.

There are thus a good many possible causes of asphyxia requiring first-aid :—

(*a*) OXYGEN MAY NOT REACH THE LUNGS because of

Lack of oxygen in the air (high altitudes ; closed compartments in ships).

Lack of any air at all (drowning).

Obstruction of air-passages (choking ; strangling ; swelling of throat).

(*b*) THE LUNGS MAY BE DAMAGED by irritant gases.

(*c*) BREATHING MAY CEASE because the brain centre which controls it has been knocked out by

Electric shock.

Drugs (morphine ; anæsthetics).

Lack of oxygen in the blood.

The shock of *choking.*

Or it may cease because of crushing pressure on the chest.

(*d*) THE BLOOD WILL NOT ABSORB OXYGEN when *carbon monoxide* has been inhaled and has turned the hæmoglobin of the red corpuscles into a useless substance.

199. Signs of asphyxia.—Shortage of oxygen may not cause deeper or quicker breathing. Indeed it tends eventually to stop all breathing, because it gradually lessens the activity of the respiratory centre in the brain.

The reason for taking another breath is scarcely ever lack of oxygen: it is almost always excess of the waste-product carbon dioxide in the blood. When the amount of carbon dioxide in the blood reaching the brain is more than a certain amount, the respiratory centre sends a message to the chest muscles and diaphragm which causes them to fill and empty the lungs so that carbon dioxide is removed. Ordinarily this happens about 14–18 times a minute.

When there is an unusual amount of carbon dioxide in the blood—for instance, after running—the brain naturally gives

orders for deep breaths in quick succession. The same thing happens when for any reason the lungs cannot get rid of carbon dioxide: there is, at first, either quick breathing or an intense endeavour to breathe.

In suffocation, when the air-passages are completely blocked, carbon dioxide cannot leave the lungs; it therefore accumulates in the blood and increasingly stimulates the respiratory centre in the brain. So long as this centre remains in action, it will go on sending frantic orders causing the chest and diaphragm to make all possible efforts to fill and empty the lungs. Soon however, the lack of oxygen will knock out the respiratory centre, and the fight to breathe will then cease.

Again, if the air-passages are freely open but the lungs have been damaged—*e.g.* by an irritant gas—there will be some difficulty in getting rid of carbon dioxide, and consequently a struggle for breath. On the other hand, where the cause of the asphyxia is failure of the respiratory centre, there will be no struggle at all; for the centre is incapable of sending orders. This is what happens when the centre is knocked out by an electric shock or (more slowly) by an excessive dose of a narcotic drug such as morphine. And in carbon monoxide poisoning, too, there is no struggle, for the centre is quickly put out of action.

Thus the appearances in asphyxia differ according to its causes.

If the air-passages are blocked, the patient will usually make violent efforts to breathe. His neck veins become distended, and his face is purple because oxygen supplies have been exhausted and the blood in his arteries is now dark in colour. His pulse at first beats strongly, but then weakens; he is soon unconscious, with staring eyeballs and in the later stages convulsive movements of the limbs. This is the ordinary picture of suffocation, though sometimes death occurs before it develops.

But when asphyxia is due to stoppage or feebleness of respiration, no fight to breathe is apparent. The lips and ears are blue (cyanosis) but the patient lies quiet, with little or no movement of the chest.

200. Treatment of asphyxia.—Obviously, when the air-passages are obstructed, the first thing to be done is to clear them. Without an airway the patient cannot breathe—no matter what else is done for him.

When the air-passages are *not* obstructed, or when the obstruction has been removed, the most urgent need is to maintain a regular flow of air into and out of the lungs, until the respiratory centre has had time to recover and the patient is able to breathe naturally again. This is done by *artificial*

respiration, and the best methods will be described in the next chapter.

Provided the air-passages are clear, artificial respiration will save the lives of a large proportion of patients whose breathing has ceased because of choking, drowning, electric shock, or poisoning by drugs or gases. It should not be used when the lungs have been damaged by irritant gases ; but apart from chemical warfare (Chap. 42) this accident is rare, and the only irritant gases at all likely to be encountered are chlorine, ammonia and nitrous fumes.

Thus the essential first-aid treatment of asphyxia is :—

Free the air-passages if necessary.

Then—unless the asphyxia is due to chlorine, ammonia or nitrous fumes—*perform artificial respiration* until natural breathing returns.

But in all serious cases, as soon as the immediate danger of death has been averted, steps must also be taken to *protect the patient from shock* : he must be kept comfortably warm. And if it is possible to *give him oxygen* to breathe, instead of air, his recovery will be hastened.

201. Obstruction of the air-passages.—The airway may be blocked in various ways. In first-aid the following are important :—

(*a*) A " foreign body " may lodge in the throat or windpipe (choking).

(*b*) The tongue of an unconscious patient may fall back into the throat.

(*c*) There may be pressure on the windpipe from outside (strangling or hanging).

(*d*) Swelling of the throat may be caused by swallowing a strong acid or alkali, or by inhaling steam, or by a sting.

Sudden obstruction of the air-passages is one of those emergencies that call for prompt action.

Obstruction by Foreign Body.—Choking may be caused by pieces of meat or crusts, coins, buttons, dentures or (in children) marbles or round sweets.

(*a*) Quickly loosen any tight clothes about the patient's neck.

(*b*) Bend him forward over a chair so that his head hangs downwards, or hold him upside down. Then thump him between the shoulder-blades to make him cough out the foreign body. (Thumping is unwise while he is sitting up.)

(*c*) If this fails, open the mouth and curl a finger round the back of the throat in the hope of hooking out the foreign body. This treatment will be equally successful if it makes the patient retch or vomit so that he pushes out the obstruction.

If the foreign body cannot be dislodged in these ways, a medical officer may be able to make an opening in the windpipe through which the patient can breathe temporarily. This operation is called *tracheotomy*.

OBSTRUCTION BY THE TONGUE.—An unconscious man lying on his back may be unable to breathe properly because his tongue falls backwards into his throat. This can be prevented by laying him on his stomach ; or by turning his head on one side, holding the jaw forward by pressing behind the angle of the jaw.

In cases of broken neck, the head cannot be turned on one side, and the tongue may have to be secured with a safety-pin (para. 152). When the lower jaw has been broken, the tongue very easily falls back and the patient should lie face downwards (para. 155).

HANGING AND STRANGLING.—When a person is found hanging, the first thing to do is to support the body so as to take the strain off the neck. Then the rope must be cut or disengaged.

Strangulation needs the same treatment: remove any constriction or tight clothes, open the mouth and apply artificial respiration.*

SWELLING OF THE THROAT.—This may be caused by burning poisons (strong acids or alkalis), by scalding hot water or steam, or by the sting of a bee or wasp.

Swelling from a burning poison (para. 216) or scald or sting may be lessened by applying cold wet cloths to the throat, from the chin to the chest, and by giving ice to suck. If breathing becomes difficult because the swollen tongue obstructs the airway, the patient should either sit up, leaning forward, or lie on his stomach with his head turned to one side.

A doctor must take charge of the case as soon as possible. In treating a sting he may give an injection of adrenaline ; but if the airway is dangerously blocked, from this or any

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* In judicial hanging in Great Britain death is not due to asphyxia through pressure on the windpipe. The rope takes the weight of the body after a drop of several feet, and the neck receives a sudden jerk which forces part of a vertebra into vital nerve centres just below the brain. In strangling death may be due to pressure on the blood-vessels of the neck rather than to asphyxia.

other cause, the only remaining means of saving life may be tracheotomy.

Obstruction of any Kind.—With any of these accidents artificial respiration may be needed to restore breathing after the air-passages have been freed. There must be no delay.

202. Oxygen.—A patient with asphyxia who is breathing, or is having artificial respiration, will always benefit if extra oxygen can be added to the air passing into the lungs; or, better still, if he can breathe pure oxygen.

Provided the air-passages are clear and the lungs are undamaged—*e.g.* in drowning, electric shock, drug poisoning or carbon monoxide poisoning—a small proportion (7 per cent.) of carbon dioxide can usefully be added to the oxygen to stimulate the respiratory centre. Since carbon dioxide is a waste-product which has to be removed by the lungs, it may seem strange to use it in treatment. But carbon dioxide is poisonous only in excess; as explained in para. 199, it is the normal stimulus to respiration, and when the breathing movements fail or weaken it can be used to increase them. If this leads to a greater intake of oxygen it helps in recovery.

In the Army oxygen is seldom given outside hospitals except by medical officers. Its administration is described in the section on nursing (para. 359).

203. Drowning.*—On removal from the water, a partly drowned person is usually cold, with bluish swollen face and hands; neither respiration nor pulse may be detectable and he may seem to be dead. But unless there is actual stiffening of the muscles, or a medical officer says that death has taken place, an earnest attempt at revival (resuscitation) must always be made. It must start immediately, on the spot, in the open air, whether ashore or afloat; and it must continue till recovery or death is certain—perhaps for many hours.

If a man removed from the water is no longer breathing, place him belly downwards on the ground, with his arms drawn forward and the face turned to one side. Clear the mouth of any obstruction, such as seaweed or dentures. Next, standing over him, lift his belly off the ground so that water in his lungs or stomach will run out. Then, without stopping to remove or loosen clothing, begin artificial respiration by Schafer's method (para. 209).

Every instant is precious. When artificial respiration is under way it will be time to think of getting medical assistance, stimulants, blankets and dry clothes.

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* Rescue from the water is described in Appendix I.

Shock may then be countered by applying hot bottles to the feet and hot flannels to the body ; similarly the circulation of blood in the limbs can be stimulated by rubbing. But so long as Schafer's method is being used it must not be interrupted—not even to remove wet clothing. If the patient can be transferred to a rocking stretcher (Eve's method, para. 210), removal of clothes will become possible.

When he is again breathing naturally, wrap him in warm blankets and move him to the nearest shelter. Further care is the same as for any other person treated by artificial respiration (para. 209). Brandy, or hot coffee or tea, will be useful when he is fully conscious and can swallow—but not before.

204. Electric shock.—Contact with an electric circuit may produce shock, insensibility or death. Often the sufferer is unable to free himself, because the current deprives him of all power of movement.

It is imperative to act at once. If possible the current should be switched off. If this cannot be done, and if the victim is still in contact with a live wire, the rescuer must take precautions before touching him. It is best to stand on a non-conductor which will resist the current—for example, indiarubber, linoleum, dry glass, dry bricks, dry sailcloth, and dry wood or straw. At any rate the hands must be protected so that the full current will not run from the victim to the rescuer : dry clothing, thick dry woollen gloves, a mackintosh, a rubber tobacco-pouch, a rubber hot-water bottle, or a folded newspaper may be used for this purpose ; or an attempt may be made to push or drag the patient away with a dry loop of rope, or a puttee, bandage or stick. All common metals and damp clothing are good conductors of electricity and must therefore be avoided in attempting a rescue.

Though the patient may seem to be dead, he can often be saved by immediate and continuous artificial respiration. Recovery is said to have taken place after as long as eight hours.*

Treatment for persons struck by lightning is the same. Both lightning and other strong electric shocks are apt to cause severe burns, which will need the same care as any other kind of burn. (*See* Chap. 26).

205. Carbon monoxide poisoning.—Carbon monoxide is a dangerous gas formed during incomplete combustion, or burning, of wood, coal, coke, charcoal, explosives, petrol and

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* A man who was revived in this way has described his feelings, when he was becoming conscious but could not move or speak, on hearing one of his rescuers remark : " We may as well give up now."

oil. It is invisible and has no smell. It may be present in large amount in :—

Coal gas supplied for heating or lighting.
Fumes from slow fires, stoves or braziers.
Smoke from burning buildings or mine galleries.
Fumes in pillboxes or gun turrets after firing.
Fumes in craters formed by exploding shells, bombs or mines.
The exhaust gases of motor engines.

There is risk of poisoning whenever the gas is liberated in any ill-ventilated space, such as a closed truck, a tank, a dugout, or a small room.

Carbon monoxide is absorbed through the lungs without irritating or damaging them. It then abolishes the oxygen-carrying power of the red blood corpuscles by changing their hæmoglobin into a valueless substance (carboxy-hæmoglobin).

Small quantities may merely cause headache, and perhaps giddiness ; but a man who breathes large quantities may be overcome in a few moments because most of his hæmoglobin has been inactivated. Thus a person who stays in a closed garage with a car engine running may collapse without warning ; he remains conscious for a short time but cannot move. When found, he may be dead or apparently dead. His lips and cheeks, however, are usually cherry-red rather than blue ; for the useless carboxy-hæmoglobin in his blood is bright carmine.

The patient must be moved into the fresh air. If breathing has ceased or is feeble, artificial respiration must begin at once, and go on, if need be, for several hours. Oxygen is particularly useful for this condition, where there is very little normal blood in circulation ; and the patient must, as usual, be kept warm.

People entering burning buildings should guard themselves if possible against carbon monoxide poisoning (*see* Appendix I). The Service respirator gives no protection.

206. Irritant gases.—Smoke from burning buildings is somewhat irritating to the lungs, but it will not harm them. On the other hand the true irritant gases—notably *nitrous fumes* and *chlorine*, and certain others used in chemical warfare—damage the lungs when they come in contact with the delicate tissues. *Ammonia* has much the same effect. Breathing does not stop, but it grows rapid and shallow, and asphyxia develops as the injured lungs become waterlogged and inefficient. Artificial respiration would be WRONG because the lung is damaged and pressure from outside might damage it further. Rest and oxygen are required.

Nitrous fumes are reddish brown or yellowish, and are produced by burning or incomplete detonation of nitro-explosives such as cordite, or by nitric acid when heated or spilt on a wooden floor. They irritate the eyes and nose and cause a little cough, but these symptoms often subside for a time, to be followed by asphyxia when, a few hours later, the lungs begin to fill with fluid. The Service respirator gives good protection for a short time, and some protection for a long time.

207. Other dangerous gases.—Apart from chemical warfare, there are several gases in common use that may cause asphyxia. *Hydrocyanic acid gas* (prussic acid gas) is employed for killing rats and bugs in ships and houses, and *hydrogen sulphide* (sulphuretted hydrogen), which smells of rotten eggs, is occasionally encountered. Both of these attack the respiratory centre, and breathing may stop instantly.

The treatment is artificial respiration; also oxygen if possible.

CHAPTER 29

HOW TO PERFORM ARTIFICIAL RESPIRATION

208. Artificial respiration is one of the most useful accomplishments of the first-aider. Properly learnt and properly performed, it will save many a life otherwise lost through suffocation, drowning, electric shock and poisoning by gases or drugs.

This chapter describes how it should be done. But it is not enough to read about artificial respiration: like bandaging, it must be practised to acquire efficiency; and without efficiency it is useless. Practise till the right movements become automatic—practise till you can do it in your sleep. Then, and then only, can you be sure of doing it correctly when the unexpected need arises.

The method that can be used by anyone, anywhere, single-handed, is that of Schafer.*

209. Schafer's method.—Place the patient, belly downwards, on the nearest firm flat surface, the head turned to one side and the arms laid forwards (Fig. 66).

Loosen any tight clothing round his neck, chest or waist, and sweep your fingers round the back of his throat to remove any obstruction such as seaweed or dentures. If the patient has been in water, stand over him and lift his abdomen a little off the ground so that water can run out of his mouth.

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* Pronounced Shayfer—rhymes with "Safer."

All this must take only a few seconds. Now begin artificial respiration * :—

Position of operator.—Kneel on one side of the patient, facing his head. Put your hands on the small of his back, the wrists nearly touching, the thumbs as near each other as possible without strain, and the fingers passing over the loins on either side, but not spread out. (Fig. 66a.)

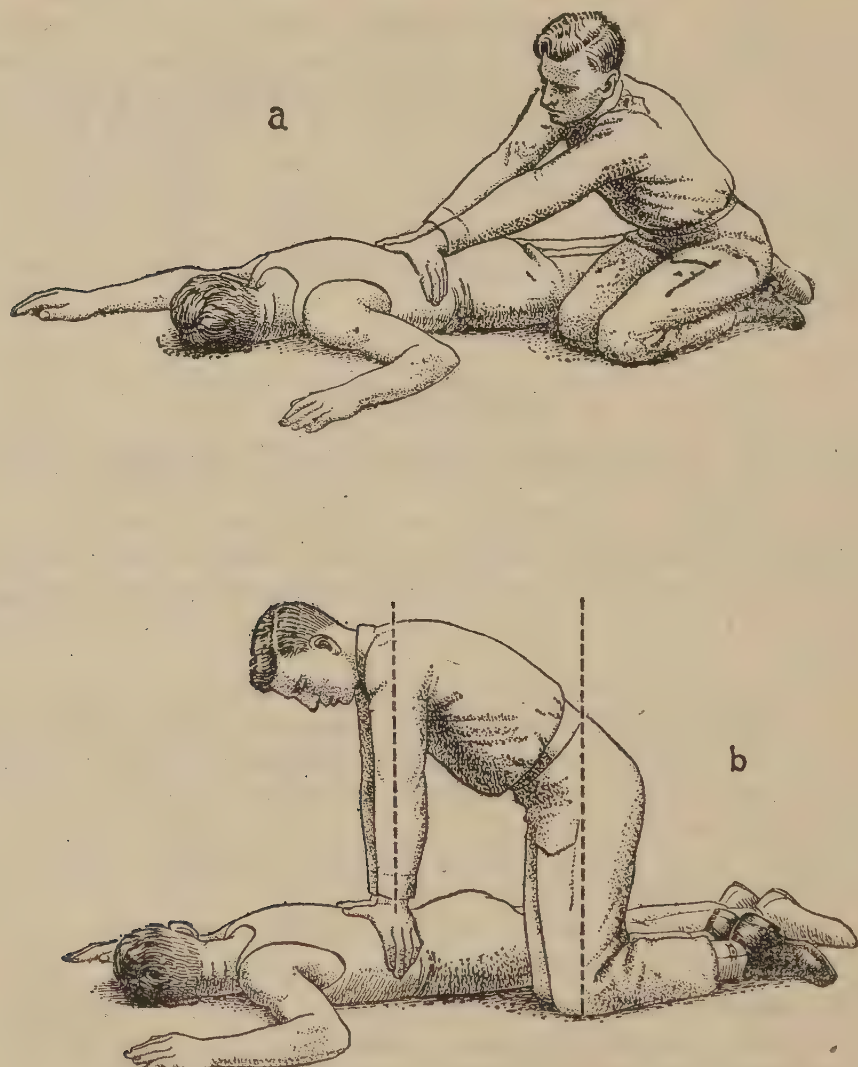

FIG. 66.—SCHAFER'S METHOD OF ARTIFICIAL RESPIRATION : (*a*) INSPIRATION ; (*b*) EXPIRATION.

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* The instructions which follow are those of the Royal Life Saving Society, adapted for naval personnel. (First-Aid in the Royal Navy, 1943.)

Expiration.—Swing slowly forwards from the knees so that your weight bears down on the patient (Fig. 66b). No exertion is required : the necessary pressure is imparted by the weight of your body. In this way the patient's abdomen is pressed against the ground ; the abdominal organs are forced against the diaphragm ; the diaphragm rises, and air is driven out of the lungs along with water or mucus which may be present in the air-passages and mouth.

Inspiration.—Next swing your body slowly backwards to its first position, thus removing its weight from the hands (which are left in place) and relaxing the pressure on the abdomen (Fig. 66a). The abdominal organs now resume their former position, the diaphragm descends, the chest is enlarged and air passes into the lungs.

Timing.—Repeat the movements regularly about 12 times a minute, swinging your body alternately forwards and backwards from the knees.

Every such double movement will occupy about five seconds —two of which may be taken up by pressure (expiration) and three by relaxation (inspiration). To ensure regularity you may count 5 slowly. As you say 1, swing forwards increasing your pressure ; 2, keep up steady pressure ; 3, begin to relax pressure ; and 4, go on relaxing pressure, so that the patient is quite free from pressure (although your hands are left in place) as you say 5. Your arms should be kept straight the whole time ; not bent at the elbows (Fig. 66b). Continue this procedure until there are signs of recovery, shown by the appearance of natural respirations. If these are ineffective or tend again to cease, artificial respiration must be resumed.

Use of helpers.—While the operator is performing artificial respiration, others may, if opportunity offers, endeavour to help restore the circulation by applying warmth by means of hot bottles and flannels to the legs and feet. But nothing must be allowed to interfere with the performance of artificial respiration ; nor must the patient be turned on his back, or receive any restoratives by the mouth, until his natural breathing is completely re-established and he is fully conscious. Such change of position may easily block the air-passages and produce fatal suffocation.

After-treatment.—When the patient is completely restored, and his ability to swallow has been tested with a teaspoonful of warm water, a teaspoonful or two of warm brandy and water may be given. He may then be placed on his side in a warm bed and be encouraged to sleep. But he must be watched for some time to see that breathing does not again fail.

210. Eve's method.—If the body is tilted head downwards, the contents of the abdomen slide towards the head and press on the diaphragm, thus forcing air out of the lungs. If the body is then tilted feet downwards, the contents of the abdomen slide towards the feet; the diaphragm is pulled down with them and air is drawn into the lungs. By putting a man along a seesaw, and alternately tilting his head and feet downwards, his lungs are emptied and filled.

This method of artificial respiration, invented by Dr. F. C. Eve, is probably more efficient than any other; it is far easier to carry on for the long periods sometimes necessary for resuscitation; and it allows removal of wet clothes and treatment of wounds or burns while artificial respiration is going on. Schafer's method has the big advantage that it can be started immediately in almost any circumstances; but if possible the patient should be transferred to a rocking stretcher at the first opportunity.

To serve as a seesaw, the stretcher can be slung, at waist height, by ropes from hooks in the ceiling (as is done on board ship), or it can be laid across a trestle or an iron bar. A couple of nails on each side will suffice to keep a rope in place; but to work easily over a trestle or bar it should be fitted with suitable wooden blocks on the under side.

The patient is rapidly placed (belly downwards) on the stretcher and his wrists and ankles are bandaged (over plenty of padding) to the handles. Or he can be held in position by ropes encircling his body and the stretcher, just above and below the buttocks or (much better) by a special brace, attached to the stretcher, which fits between his legs, divides, and fastens over his shoulders. The stretcher is then tilted up and down, about 12 times a minute, for as many minutes or hours as may be necessary.

One man cannot carry on artificial respiration by Schafer's method for more than a moderate time without fatigue, and relays of helpers are often required. Unskilled assistants may be inefficient and may even do damage by using undue force. With Eve's method, on the other hand, little energy or skill are required for rocking the stretcher; there is no risk of harm; and the patient can be kept warm while being revived.

211. Silvester's method.—This may be needed when a patient cannot be turned face downwards. He lies flat on his back, with a pillow or folded blanket under his spine. His head is turned to one side, with the neck bent backwards. The operator kneels at the head, facing the patient's feet, and grasps his arms at the elbows. Air is drawn into the lungs by bringing the patient's arms up above his head. It is then expelled from the lungs by bringing the arms down and folding

them over the chest with the elbows touching; in doing this the lower part of the chest should be compressed. The arms are raised and lowered in this way about 15 times a minute.

This method will be useless if the patient is unconscious and the tongue falls back and blocks the throat; a clip or safety-pin may then have to be put through the tongue so that it can be held forward. It is also less suitable for the partially drowned, because the water in the air-passages cannot run out.

CHAPTER 30

POISONING

212. Varieties of poisons.—There are a great many different kinds of poisons, and they can be classified in many different ways. For purposes of first-aid, it is particularly important to know which ones are likely to burn the tissues if they get inside the body. All poisons, it will be found, belong to one or more of the following groups :—

A. Burning Poisons.

B. Non-Burning Poisons.

(i) Irritant poisons.

(ii) Systemic poisons.

Burning poisons.—Acids and alkalis, and certain powerful disinfectants, can actually burn the parts they touch—the lips, the tongue and the stomach. This burning causes swelling in the mouth and throat which may interfere with breathing. A strong acid or alkali can destroy the lining of the œsophagus and stomach. The patient usually suffers from great pain and shock.

Irritant poisons.—Arsenic, phosphorus, zinc salts, and occasionally poisonous substances in shellfish and fungi (toadstools, etc.), inflame the tissues with which they come in contact, and cause pain, vomiting and diarrhœa—often to the point of danger. While they may produce inflammation of the wall of the stomach they do not destroy it as strong acids and alkalis do.

Systemic poisons.—Certain poisons, including some of the burning and irritant poisons, are absorbed into the tissues of the body. They enter the system through the stomach, or (if they are gases) through the lungs, or through the skin, or through the rectum. Once absorbed they may attack important centres in the brain, either deadening them or irritating them, or they may affect the blood or various organs. For example, morphine and alcohol in large quantities deaden or dull the brain: the result may be unconsciousness and

failure of breathing (asphyxia). Strychnine and atropine,* on the other hand, excite the nervous system and produce convulsions, and so do some of the poisons of fungi. Carbon monoxide causes asphyxia and unconsciousness by reducing the oxygen-carrying capacity of the blood, as was explained in the last chapter.

213. Essentials of treatment.—In cases of poisoning a medical officer should always be summoned ; but the action taken before he arrives will often decide whether the patient lives or dies.

The orderly must ask himself two questions :—

(*a*) *Is the patient in danger of death from asphyxia ?*
If so, TREAT FOR ASPHYXIA at once (para. 214).

(*b*) *What is the poison ?*
If it is a STRONG BURNING POISON—immediately DILUTE IT by giving plenty of water, and as soon as possible NEUTRALIZE IT (para. 216).
If it is NOT a strong burning poison—EMPTY THE STOMACH (para. 217).

214. Is there danger from asphyxia ?—In cases of poisoning the patient may suffer from asphyxia :—

(*a*) Because he is lying unconscious on his back and his tongue has blocked the airway.
(*b*) Because his throat and windpipe are swollen.
(*c*) Because the poison has dulled the respiratory centre in the brain which controls breathing movements. Many drugs—especially those which are normally used to relieve pain and induce sleep—are capable of stopping respiration when taken in large doses.
(*d*) Because the blood has been rendered inefficient.

The lips will be bluish—except in carbon monoxide poisoning when they will probably be cherry-red. If the air-passages are blocked, or partly blocked, the patient may for a time make great efforts to breathe. Otherwise his breathing will be feeble and insufficient, because the respiratory centre in the brain is poisoned or starved of oxygen. At this stage he is likely to be unconscious.

Other treatment for poisoning will be of no avail if the patient cannot, or does not, breathe. Hence, if asphyxia seems to threaten life, the first thing to do is to relieve it. Lay him on his stomach with the head on one side : this will prevent the tongue from blocking the throat. Then, if breathing is poor, start artificial respiration by Schafer's

* This drug, which is widely used in medicine, is obtained from the belladonna plant (deadly nightshade).

method (para. 209). In many of these cases the medical officer will give oxygen, or oxygen with carbon dioxide 7 per cent.

When the patient has taken a strong burning poison (as defined in para. 216) there may well be some asphyxia from swelling of the throat, but it is seldom dangerous at first. Here the urgent need is to dilute and neutralize the acid or alkali. Afterwards cold wet cloths can be applied to the neck, from chin to chest, to reduce or prevent swelling; and he may have ice to suck.

215. What is the poison?—If the patient is not dangerously asphyxiated, treatment is none the less urgent; but before going further one must try to decide whether one is dealing with a strong burning poison, which would make it risky to give an emetic or wash out the stomach through a tube.

Information may be got from the person bringing the patient or from the patient himself, if conscious. The important questions are :—

Was the poison swallowed?
What was it?
Was there a bottle beside the patient? Was it labelled?
Has it been brought?

Note (*a*) whether the breath smells of any recognizable substance, and (*b*) whether the lips and mouth are burnt or discoloured. The vomit from a burning poison is brownish or blackish and may stain clothing and carpets. The patient feels pain from the mouth to the stomach.

If the state of the mouth, or the vomit, or the pain, suggest a burning poison, one still has to find out if possible whether it is a weak one or a strong one, and, if it is a strong one, whether it is an acid or an alkali. Often the circumstances or the smell will provide the clue. If the breath smells sour it is probably an acid.

216. Burning poisons.—For practical purposes the burning (corrosive or caustic) poisons are classified as follows :—

WEAK

Carbolic disinfectants.—Carbolic "acid" (phenol); Lysol, cresol, etc. These have characteristic smells.

Weak acids.—Oxalic acid (salts of lemon); acetic acid.

STRONG

Strong acids.—Sulphuric acid (oil of vitriol); hydrochloric acid (spirits of salt); nitric acid.

Strong alkalis.—Caustic soda; caustic potash; strong ammonia.

Weak burning poisons are treated like non-burning poisons ; that is to say, they are removed from the stomach as soon as possible, by means of an emetic if the patient is conscious, or with a stomach-tube. A person poisoned by a carbolic disinfectant may quickly become unconscious, because the poison is absorbed into the tissues, and artificial respiration may be the most pressing need.

When a strong burning poison has been taken, it is unsafe to wash out the stomach or induce vomiting. All that can be done is to dilute the poison immediately with drinks of water and neutralize it at the earliest possible moment.

Neutralizing strong acids and alkalis.—Acids and alkalis neutralize one another ; that is to say, a mixture of them in suitable proportions is neutral and harmless. A strong acid can be prevented from doing further damage if it is neutralized by giving an alkali, and a strong alkali can be neutralized with an acid. Naturally, for this purpose we choose weak alkalis and weak acids which could do no damage on their own account. Naturally, too, strong acids and alkalis are less harmful when diluted with water.

For a strong acid give magnesia (say 4 tablespoons of the powder in a pint of water for an adult). Or lime-water or chalk and water. Or, if none of these are at hand, plaster scraped from walls and ceilings may be given mixed in water. N.B.—Bicarbonate of soda (baking soda) is *not* suitable, because on contact with acid it forms much gas which might burst open the damaged stomach.

For a strong alkali give a weak acid. The best is vinegar (3 oz. in a pint of water). The juice of six lemons, or lime juice, would do very well.

Any burning poison.—If it cannot be discovered quickly whether the burning is due to a strong or a weak poison, an acid or an alkali, it will at least be possible to dilute it with plenty of water. Plenty of *milk* is even better, and can usefully be given in any of these cases, either immediately or after neutralization of the poison. So can raw eggs and olive oil, if available.

217. Non-burning poisons.—When a poison has been swallowed and is neither a strong acid nor a strong alkali, the best way to get rid of it is to wash out the stomach through a tube (gastric lavage). If this cannot be done at once the patient—provided he is conscious—should be made to vomit. This will be unnecessary if he is already vomiting frequently and profusely ; but even severe vomiting does not remove the

necessity for washing the stomach thoroughly through a tube when there are facilities for doing so.

Emetics cause vomiting. The following are the commonest :—

- Mustard powder, one tablespoonful in half a tumbler of water.
- Common salt, one tablespoonful in half a tumbler of water.
- Ammonium carbonate, half a teaspoonful in half a tumbler of water.
- Zinc sulphate, half a teaspoonful in half a tumbler of water.
- Ipecacuanha powder, half a teaspoonful in half a tumbler of water.
- Ipecacuanha tincture, one tablespoonful in half a tumbler of water.

The dose should be swallowed quickly.

Tickling the back of the throat with a feather, or gently with the finger, may be successful, and should be tried if no emetic is handy. A medical officer may use a hypodermic injection of apomorphine hydrochloride (grain 1/10).

Gastric lavage by a stomach-tube is by far the most effective method of removing poison from the stomach, but (like emetics) it must not be used when strong acids or strong alkalis have been swallowed. The apparatus required is :—

- A rubber stomach-tube, preferably 60 inches long, or (if shorter) with an extension to make up this length by a glass tube connection. The tube should be marked with indelible pencil at 20 inches from the tip for an adult ; or a safety-pin may be put through it to mark this point.
- A funnel to fit the end of the tube if there is no rubber cup at the end.
- Two mouth-gags.
- A tongue-clip.
- A jug, pint size.
- Two buckets, one containing 16 pints of warm water.

An orderly, unless specially trained, is unlikely to be competent to pass a stomach-tube, and details of the introduction are therefore omitted. The process of lavage consists in repeated flushing of the stomach with water—for an adult a pint at a time—until all the poison has been washed away. This requires *at least* 16 *pints of fluid.* The first pint returned should be saved for examination.

The patient must lie face downwards, as shown in Fig. 67. If he lies on his back, or sits up, he will have difficulty in breathing, and the stomach will not be properly washed out. This has been the cause of many failures.

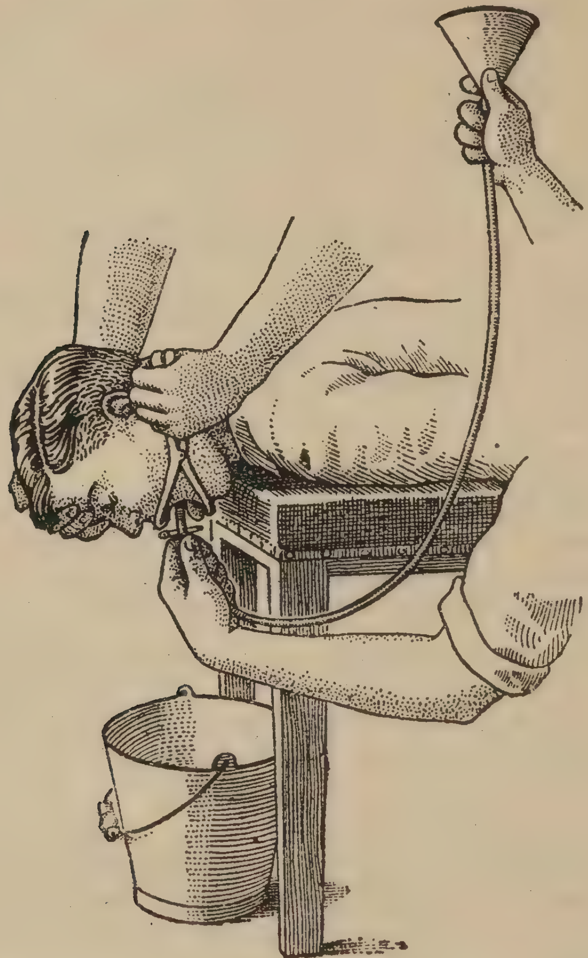

Fig. 67.—Washing Out the Stomach (Gastric Lavage).

218. Antidotes.—If the poison is recognized, and there is an antidote or substance which is known to counteract it, this substance may be added to the water used for stomach lavage. The following is a list of such substances and the amounts of them that should be added to 16 pints of water.

Poison	*Antidote added to* 16 *pints water*
Antimony	Tannic acid, 180 grains.
Arsenic	Freshly precipitated ferric hydroxide (*see* below).
Atrophine (belladonna)	Potassium permanganate, 60 grains.

Poison	*Antidote added to 16 pints water*
Barium salts	Magnesium sulphate, 2 oz.
Cocaine	Potassium permanganate, 60 grains.
Cyanides	,, ,, ,, ,,
Fungi	,, ,, ,, ,,
Iodine	Thin starch paste or flour and water.
Lead salts	Magnesium sulphate, 2 oz.
Opium and morphine	Potassium permanganate, 60 grains.
Oxalic acid	Magnesium oxide, 4 oz.
Phenol (carbolic)	Magnesium sulphate, 4 oz.
Phosphorus	Copper sulphate, 15 grains.
Silver nitrate.	Common salt (sodium chloride), 2 oz.

It should be understood, however, that the antidote is of far less importance than the washing.

Precipitated ferric hydroxide is made by adding to 2 oz. of liquor ferri perchloridi either an equal quantity of a saturated solution of washing-soda, or solid washing-soda (sodium carbonate) till effervescence ceases, and straining out the precipitate through a handkerchief. All the precipitate obtained may be added to the lavage water.

A *general antidote*, for use in any case where the poison is unrecognized, may be made by mixing precipitated ferric hydroxide with equal parts of magnesia and of charcoal. The mixture is given in water, to drink freely.

219. Treatment of effects of poisoning.—The treatment of some of the effects of poisoning is beyond the scope of an orderly, but he may be able to help by making preparations. For example, nikethamide (Coramine) or strychnine by hypodermic injection, or intravenous saline solution, may be required for coma; morphine hypodermically for pain; or intravenous saline for great loss of fluids by vomiting and diarrhœa.

220. Summary of treatment.—Do not lose your head. Send for medical aid immediately.

If the patient is in trouble with his breathing, keep the air-passages clear by turning him over on his stomach with the head on one side, and if necessary apply artificial respiration.

If there is evidence that he has swallowed a *strong* burning poison (strong acid or strong alkali), and if he is conscious, give water at once and neutralize the acid or alkali as soon as possible. If he has swallowed any other poison, give an emetic if he is conscious and in any case get ready the stomach-tube.

Save any vomit for examination. Keep any bottle brought with the patient.

Keep the patient warm. Never give anything by mouth to an unconscious patient. Anticipate as far as possible the needs of the medical officer.

CHAPTER 31

ABDOMINAL PAIN AND VOMITING

221. Pain is a danger signal, and anyone with persistent or increasing pain in the abdomen should see a medical officer at once. Very often there is vomiting as well as pain ; and it is easy to mistake the early symptoms of some serious condition, such as appendicitis, for a stomach-ache or a bilious attack. Diagnosis should be left to the medical officer ; but the orderly may be called upon to give first-aid to someone in pain, so he should know something of the possible causes. Experience and knowledge will make him more cautious about attempting treatment, and more prompt in seeking medical aid.

222. Stomach-aches and food-poisoning.—" Pain in the stomach," with vomiting, may follow over-eating, over-drinking, or other dietary indiscretion : most people get a pain if they eat green apples, and some get one after lobster. A dose of castor oil may be good treatment—but not if there is a chance that the patient really has an inflamed appendix. Many a death from appendicitis has been caused by an ill-timed dose of " opening medicine."

If several men simultaneously develop pain and vomiting, the probability is that they have been poisoned or infected together. Often it will be found that they have all partaken of food or water containing a poisonous substance or a germ which has irritated and inflamed their stomachs. There may be little pain but much vomiting, and probably diarrhœa when the poison or infection gets down into the intestine.

If there is good reason to attribute the symptoms to an irritant poison, treatment should follow the lines laid down in para. 217. Otherwise the condition should be treated provisionally as *bacterial food-poisoning*—that is to say, acute inflammation of the stomach and bowel caused by germs in contaminated food or drink. The patient should be kept warm, and as comfortable as possible, till a medical officer sees him. A serious risk is collapse from loss of fluid, and he should take frequent sips of water unless this makes him vomit more. (For later treatment, *see* para. 433.)

223. The "acute abdomen."—This somewhat unscientific term is used by doctors to embrace all the dangerous conditions that may arise in abdominal organs and need surgical operation. The two principal dangers are :—(*a*) *peritonitis* (inflammation of the *peritoneum* or membrane which lines the walls of the abdominal cavity and covers the bowel), and (*b*) intestinal obstruction.

Peritonitis.—A man who has a gastric or duodenal ulcer, causing indigestion and sometimes vomiting an hour or two after meals, may suddenly complain of severe pain, which is followed by partial collapse with pale face and rapid pulse ; the upper abdominal muscles are tense. The reason may be that his ulcer has broken through the wall of the stomach or duodenum and the contents of these organs are passing out into the abdominal cavity where they will set up peritonitis. He has little chance of life unless a surgeon can repair the hole.

Commoner than this catastrophe is *appendicitis*, or inflammation of the appendix (Fig. 22, page 42). The pain may start round the navel (*umbilicus*) but often settles down in the bottom right-hand corner of the abdomen, where tenderness may be detected, and perhaps protective stiffening or rigidity of the muscle wall. As a rule the temperature and pulse-rate rise a little, and there is almost always nausea or vomiting.

If the patient were put in Fowler's position (Fig. 75, page 220), and given nothing by mouth, he might recover spontaneously within a few days ; but in all cases of appendicitis there is a grave risk of infection spreading through the abdominal cavity (general peritonitis), and immediate operation is almost always the safest course.

Intestinal obstruction.—The bowel may become twisted or telescoped or blocked or constricted in such a way that its contents cannot move onwards ; or the blood-supply or nerve-supply of a section of the gut may be cut off, so that it becomes paralysed, or dies, and nothing passes through it. A patient with acute intestinal obstruction of this kind has great pain and vomiting, and his abdomen later distends. He is in grave danger, and only the surgeon can save him.

One of the commonest causes of obstruction is stoppage of the blood-supply to a piece of bowel in a *hernia* or rupture.

In hernia part of an organ protrudes through a gap in its coverings ; and the commonest form of hernia is a protrusion of bowel between the muscles forming the abdominal wall—especially at the umbilicus and at the inner end of the groin (*inguinal region*), where the bowel may bulge down into the scrotum. The muscles at the neck of the hernia, where it

passes through the abdominal wall, occasionally interfere with the return of blood from the protruding piece of bowel, which thereupon swells. When the bowel in the hernial sac becomes swollen, for this or any other reason, the pressure may cut off its blood-supply completely (*strangulated* hernia) and if this state of affair continues the bowel will go gangrenous.

The patient has pain, usually vomiting, and increasing signs of collapse.

224. Other causes of severe pain.—As explained later (para. 413), disease of the blood-vessels in the heart may lead to attacks of pain (*angina pectoris*) usually felt at the lower end of the sternum but sometimes in the upper abdomen. The patient may be in agony—pale, often rigid and motionless, and with shallow difficult breathing.

Very intense pain may also be caused by the passage of a gall-stone through the narrow tube by which the gall-bladder empties its contents into the duodenum (Fig. 22, page 42). In this *gall-stone colic* the pain usually starts in the gall-bladder region but may radiate in all directions over the abdomen ; and it continues, in paroxysms, until the stone is pushed into the gut. *Renal colic* due to the difficult passage of a kidney stone through the ureter to the bladder (Fig. 23, page 46), is very similar except that the pain ordinarily begins in the loin. In both conditions the patient may be faint and sweating, with a rapid feeble pulse and perhaps fever.

Abdominal pain and vomiting may also be the first symptoms of some of the infectious fevers, and of many rarer conditions.

225. Reporting to the medical officer.—Though the orderly should not take it upon himself to make a definite diagnosis in any of these cases, he can give valuable assistance by sending the medical officer an accurate and informative message or report. This might usefully include, for example, the following particulars :—

Age and *sex* of the patient.

Pain.—Time of onset. Severity. Kind of pain. Situation. Direction in which it radiates. Continuous or not. Previous attacks or not.

Vomiting.—Time of onset. Frequency. Amount and character of vomit.

Action of bowels.—Constipation or diarrhœa. Colour of motions.

Temperature, pulse-rate and *respiration-rate.*

General condition.—Colour. Collapsed or not. State of mind.

Any apparent cause.—Error of diet. Hernia. History of ulcer, gall-bladder, heart or bladder trouble.

226. Treatment for abdominal pain.—What is chiefly important is to make the patient comfortable (without doing him harm) and get him under medical care as soon as possible.

He should always be kept warm, if necessary with hot bottles. Heat may also give some relief if applied to the site of pain, and it is always harmless—except in hernia, which is better treated with cold.

Treatment of hernia.—In all cases where a swelling suddenly appears in the groin or at the umbilicus, or where a swelling in one of these places suddenly enlarges or grows painful, the patient should lie down with the knees raised and the swelling should be covered with a cold compress (para. 362) or a cloth soaked repeatedly in cold water. Such swellings should be handled as little as possible.

In any patient with an " acute abdomen " it is dangerous to give morphine before the medical officer has made his diagnosis. The drug may relieve the pain, but it may also prevent discovery of the cause until too late. In cases of stomach-ache a purgative like castor oil may be beneficial 99 times out of 100 ; but in the 100th case it may make an inflamed appendix rupture, or have other equally disastrous results. Treatment with medicines and drugs should be left, therefore, to the medical officer.

Patients possibly suffering from a perforated ulcer should be given nothing by mouth. Others may have sips of water.

CHAPTER 32

THE EYE AND THE EAR

227. Foreign bodies in the eye.—Particles of grit or coal dust or steel may lodge on the eyeball or inside a lid, causing much discomfort. As a rule they are soon washed away by the tears ; but if they stay long they can give rise to inflammation and very real pain.

Treatment.—The eye can often be cleared by blinking it repeatedly under water in a basin for a minute or two. If this fails, the patient should be placed facing a good light, and a careful search should be made for the cause of the trouble.

If the foreign body can be seen on the eyeball, it can usually be wiped off with the corner of a handkerchief or with a piece of lint. If it proves to be embedded in the eyeball, its removal should be left to a medical officer. Meanwhile insert a few drops of sterilized oil between the lids ; tell the patient to close the eye, cover it with a piece of lint, and lightly bandage.

If the foreign body cannot be seen, draw down the lower lid gently and look at its inner surface, removing any particles found. This lower conjunctival pouch is easily explored. The inside of the upper lid, on the other hand, cannot be properly searched unless the lid is turned inside out (*everted*). Before trying to evert the upper lid it is a good plan to pull it down over the lower lid and then let it slip back to its normal position. This should be done several times; if there is a foreign body on the inside of the upper lid it will perhaps be wiped away by the lashes of the lower lid.

After removal of a foreign body, the pain may take a few minutes to go away. If it continues unabated, the upper lid must be everted and its inner side examined. Place the patient in a chair facing a good light, and stand behind him on the same side as the affected eye. Take a probe in the left hand for the left eye, or in the right hand for the right eye; tell the patient to close the eye lightly and look downwards,

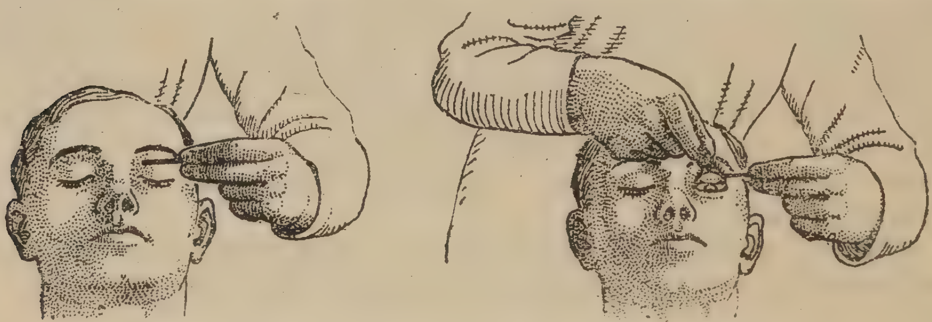

FIG. 68.—EVERTING THE UPPER EYELID.

and lay the probe horizontally along the eyelid about half an inch from the free edge (Fig. 68). Then grasp the lashes or the free edge of the lid with the forefinger and thumb of the disengaged hand, and (maintaining steady slight pressure backwards and upwards with the probe) gently turn the lid up over the probe and look for the foreign body on the everted lid.

A match makes a good substitute for the probe.

228. Burns and scalds of the eye.—Scalds by hot water or steam, and burns by hot ashes or alkalis or acids, are very serious. Prompt action must be taken.

Treatment.—If hot water, or steam, or hot ashes injure the eye, bathe it very gently with warm boracic lotion, and cover it with an eye-shade.

When the eye is burnt by an acid or alkali, as much as possible of the harmful substance must be removed by blinking the eye under water, or by flushing it out with fluid at the

earliest possible moment. Ideally a mildly alkaline fluid (such as 1 per cent. bicarbonate of soda) should be used for acid burns, and a mildly acid fluid (such as boracic lotion or equal parts of vinegar and water) should be used for alkali burns—those caused, for example, by quick-lime or ammonia. But the really important thing is to use *plenty of fluid* and use it *quickly*. Saline solution is excellent, but plain water (*e.g.* from a water bottle) will do very well.

Castor oil and olive oil are best avoided in the first-aid treatment of all these burns, and the eye should be protected by a shade rather than a pad and bandage. Treatment for shock may be needed, and the patient must see a medical officer or be sent to hospital without delay.

229. Damage to the ear.—Foreign bodies, such as insects, sometimes get through the ear-hole into the external auditory canal (Fig. 32, page 58), thereby causing deafness, irritation or pain.

A live insect in the ear can be killed by putting in a few drops of oil. Then, like any other foreign body, it can be removed by syringing, as described in para. 382. Attempts to remove a foreign body with forceps or a probe should not be made except by a medical officer. For people inclined to such experiments a wise rule is: "Never put in your ear anything smaller than your elbow."

The drum of the ear is occasionally ruptured by blast from gunfire or high explosives. The patient feels a sharp pain and complains of deafness, and there may be a little bloodstained discharge. The immediate danger is infection of the middle ear. A small piece of clean dry cotton-wool should be inserted into the ear-hole (but not tightly plugged), and the patient should be sent to a medical officer. On no account should drops be applied, and the ear must *not* be syringed.

To prevent rupture of the drum, and possible deafness, the ears can be protected with soft plugs (e.g. cotton-wool); or sometimes, in an emergency, with the fingers.

CHAPTER 33

BITES AND STINGS

230. Bites of animals.—The bites of dogs, cats and other animals are often troublesome because the flesh is lacerated and germs are carried into the wound by dirty teeth. But the first-aid treatment is the same as for any other wound: a dry dressing is applied and the patient is referred to a medical

officer. When the bite is a bad one, care must as usual be taken to minimize shock by means of warmth, rest and fluids.

Special precautions will be necessary, however, if there is any reason to think that the animal may be "mad"—*i.e.* has *rabies*. This disease, though almost extinct in Great Britain, is not uncommon in some countries abroad, being transmitted usually by dogs, but also by cats, foxes, wolves and jackals. Infected dogs show a change of character, becoming sulky and unsociable (or maybe excessively affectionate) and later running amok, often foaming at the mouth.

The virus or germ of the disease is in the animal's saliva, and it can be conveyed by a dog licking its master's hand where the skin is broken. Nearly always, however, it enters through a bite. The disease in man is called *hydrophobia* (meaning fear of water), because in the later stages the patient, though very thirsty, goes into convulsions whenever he tries to swallow or even hears the sound of water running.

The first-aid treatment is to prevent the virus passing from the wound into the blood-stream :—

(*a*) Apply a tourniquet or band above the wound, tightly enough to prevent blood travelling towards the heart.

(*b*) Hold the wound under a fast-flowing tap ; or suck it vigorously, spitting out the blood.

(*c*) Destroy the virus by pouring a spirit, or tincture of iodine, or some other antiseptic into the wound.

The tourniquet must not, of course, remain in position for long ; and at the earliest opportunity the wound should be cleansed and cauterized by a medical officer.

Such measures may or may not succeed. To be sure of preventing hydrophobia in an infected person, it is necessary to give a series of injections (*Pasteur treatment*). These are practically certain to be effective if begun within a week of the bite. Naturally, before undertaking them, it is an advantage to be sure that the biting animal really had rabies. If the animal has been shot, its body must be kept so that the medical officer can send parts of the brain for examination in a laboratory. If the animal has been caught, it must be kept under observation. Any animal that survives as long as ten days cannot possibly have had the disease.

231. Snakebite.—Poisonous snakes carry their venom in the head in poison glands, from which it passes to two hollow or grooved fangs in the upper jaw. These fangs, which are much larger than the ordinary teeth, are present only in poisonous snakes. In stations abroad all snake bites should be regarded and treated as poisonous unless proved otherwise.

Some snake poisons are very deadly and cause death rapidly. So, if life is to be saved, first-aid treatment must be immediate. Its aims are (*a*) to prevent the poison from reaching the general circulation, and (*b*) to remove as much poison as possible from the body.

Bites on the Limbs.—Fortunately most bites are on the limbs—usually on the hands. The treatment required is :—

(*a*) Apply a tourniquet *at once*. There are only two places to apply a tourniquet. If the bite is on the hand, forearm or arm it should be put on the upper part of the arm (above the bite) ; if the bite is on the leg or foot it should be applied about the middle of the thigh. Tourniquets elsewhere are useless. The tourniquet should be tightened until the pulse at the wrist or ankle can no longer be felt.

Remember that every second's delay in applying the tourniquet increases the amount of poison absorbed and the risk to life.

(*b*) Now wash the skin over the bite (to remove any poison there) and make two parallel cuts over the bite. Each cut should pass through a fang wound and should be 1 inch long and $\frac{1}{4}$ inch deep. A safety-razor blade makes an excellent knife.

The tourniquet should be applied, and the cuts made, without waiting for a medical officer. If, when that has been done, a medical officer is not available immediately, do not wait, but proceed with the next step.

The tourniquet will prevent absorption of the poison into the general circulation, but a limb may be permanently damaged by cutting off its blood-supply completely for more than a quarter of an hour. So it is necessary to get rid of the poison in the wound at the earliest possible moment. For this purpose :—

(*c*) A second tourniquet is applied just below the first. It should not, however, be tied so tightly, its object being to stop the flow of blood in the veins but not the arteries. The first tourniquet is now loosened. The cut wound, which so far has not bled, starts to bleed freely. If it does not, the second tourniquet is too tight and should be loosened until the veins below stand out like cords.

Any small vein seen to stand out prominently under the skin near the bite should be opened by cutting it across, and should be allowed to bleed until at least a pint of blood has been lost. A

large proportion of the poison can be washed out in this way. When the required amount of blood has been withdrawn, the tourniquets are removed. Bleeding can be stopped by applying a pad directly over the incision.

Bites on the Trunk or Face.—No tourniquet can be used. To remove the poison and promote bleeding, suction is needed. A heated wide-mouthed bottle applied over the wound and allowed to cool gives powerful suction. Suction by mouth is safe if there is no cut inside the mouth. The material sucked into the mouth should not be swallowed.

Bites in any Situation.—If the patient shows signs of collapse, give a stimulant; brandy, hot coffee and tea are useful.

If antivenine is available it will be injected intravenously by the medical officer. The orderly should therefore make preparations for an intravenous injection.

Do not rub potassium permanganate crystals into the wound. They do no good, and they damage the tissues.

232. Insect bites.—The bite of an insect may introduce the germs of a disease: for example, malaria is transmitted in this way by mosquitoes, plague by fleas, and typhus by lice. Mosquito bites occasionally introduce other germs which cause inflammation, pain, and even "blood-poisoning." If the site of a bite becomes red and tender—and especially if there is a red line running up from it as described in para. 44—the patient should be seen by a medical officer. This type of infection can usually be prevented by dabbing a little antiseptic, such as iodine or Dettol, on the skin where it has been bitten.

233. Insect stings.—The stings of bees, wasps and hornets rarely cause anything worse than a few minutes' pain. But a sting inside the mouth (*e.g.* by a wasp in jam) can produce rapid and dangerous swelling of the tongue or throat—dangerous because it may block the airway. From time to time, also, a sting in some other part of the body is followed by faintness and collapse, either because the insect has injected its poison straight into a small vein, or because the patient happens to be very sensitive to it.

Treatment.—The first thing is to remove the sting. In doing this one should avoid pressing more poison into the skin from the poison-bag which may still be attached to the sting. The best plan is to scrape the sting away with a knife-blade or the edge of a long finger-nail.

There are many popular remedies which are rubbed on the skin to take the pain away—for example, methylated spirit, brandy, ammonia, soap, soda, and vinegar—but they can

seldom reach and neutralize the poison, which is inside or under the skin.

If the sting is in or near the mouth, and therefore important, it will be worth trying one of these remedies, diluted where necessary, as a mouth-wash—*e.g.* vinegar and water (equal parts), brandy, whisky, or a solution of bicarbonate of soda. Ice to suck, or plenty of cold water, will help to keep down swelling, and cold compresses may be applied to the throat. A medical officer should be summoned.

A person who collapses after a sting must be treated for shock. Lay him down with the head low, loosen the clothing and keep him warm. Brandy, whisky, or hot strong coffee or tea will be useful if he can swallow.

Irritation from stings of various kinds can be lessened by applying a strong solution of bicarbonate of soda, or a weak solution of carbolic acid (5 per cent.).

234. Scorpion stings.—Scorpions, which belong to the same family as spiders, are common in many tropical and subtropical countries; they are also found in the south of Europe. They frequent dry or stony places, and may creep under the blankets of men sleeping in the desert. Scorpions may be black or flesh-coloured, and from 3 to 9 inches long. The powerful sting is carried at the end of the tail. Its action is extremely painful, and in children may even be fatal.

Treatment.—All that can ordinarily be done is to relieve pain. A drop of strong ammonia, which can be applied with the stopper of the bottle, is very effective; diluted ammonia is also useful. Afterwards a cold compress may be applied.

235. Spider bites.—Spiders usually have poison glands, but as a rule the venom is only dangerous to insects and small birds. The bites of some tropical spiders may, however, have severe effects in man, including inflammation, swelling, and sometimes sloughing.

Treatment.—The wound should be washed with a solution of potassium permanganate (1 in 4,000).

CHAPTER 34

HEAT-STROKE

236. Men overcome by heat may be suffering from *heat prostration*, which is seldom very serious, or from *heat hyperpyrexia*, which is always very serious indeed. In both conditions the heat-regulating mechanism becomes unreliable;

and they are conveniently grouped together as *heat-stroke.* Heat-stroke following exposure to the rays of the sun was formerly called sun-stroke, but there is no reason to suppose that it differs in any way from heat-stroke following exposure to other forms of heat.

Prevention of heat-stroke is important. With ordinary care the danger of ill effects from heat is not great, but in hot weather in the tropics it is generally advisable to avoid excessive fatigue and unnecessary exertion during the hotter part of the day. All personnel should be encouraged to drink more water than they want to quench their thirst, for people tend to drink less than they require for replacement of the fluid they lose as sweat. The diet or drinking-water should contain extra salt; alcohol should not be taken before sundown; and both clothing and accommodation should be suited as far as possible to the climate. In camps and barracks special stations may be established to provide immediate treatment for heat-stroke casualties if they arise.

237. Heat prostration.—This is seen chiefly in personnel working or marching in the heat, especially when the air is moist as well as hot. In hot damp weather the stokers in boiler-rooms sometimes collapse in this way, but it mostly affects people who are unaccustomed to great heat and have not yet become acclimatized to it—for example, new arrivals in the tropics. It is a form of fainting attack, and the symptoms are those described in para. 187: the patient feels giddy and queer; he staggers and may fall unconscious; his face is pale, his pulse is weak, his pupils are dilated, and he comes out in a clammy sweat. His temperature is not raised; it is normal or below normal. In severe cases, where there has been a lot of sweating, there are cramps of the muscles, caused by loss of salt in the sweat (*fireman's cramp*).

Treatment is the same as for any other faint. Place the patient, lying down, in the coolest available airy place; loosen any tight clothing, particularly about the neck; if he can swallow, give him a reviving drink such as cold water or sal volatile ($\frac{1}{2}$–1 teaspoonful of aromatic spirit of ammonia in half a cup of water). If there are cramps, add a little salt to the water (1–2 teaspoonfuls to the pint). If the patient feels cold, keep him comfortably warm, if necessary with hot bottles to the feet.

Though rapid recovery is usual, fatal collapse is possible. All cases of heat prostration should be reported to a medical officer, for sometimes these patients do not recover completely for a few days, and occasionally they develop heat hyperpyrexia later.

238. Heat hyperpyrexia.—Hyperpyrexia is a term used for body temperatures of 106° F. or more.* If a person exposed to heat is unable to keep his temperature down in the usual way by sweating and evaporation, it may rise dangerously. This happens most often in those who are already feverish because of some infection such as malaria or sandfly fever, and in hot weather in the tropics hospital patients have to be watched closely by day and night to make sure they are treated promptly if their temperature runs dangerously high.

A fit man who drinks plenty of water and eats plenty of salt is unlikely to develop heat-stroke under any conditions of climate ; but care is needed in any fever or when acute diarrhœa or vomiting has reduced the amount of fluid and salt in the body. In very hot weather a drinking-bout which upsets the liver will greatly increase the risk of heat hyperpyrexia during the following few days.

Sweat contains salt. When, through prolonged perspiration or any other cause, the body begins to run short of salt, it tries to save its remaining salt by reducing sweating to a minimum. This means that the body is no longer cooled by evaporation of fluid from the skin, and the temperature begins to rise. Hence dryness of the skin, in a person who has previously been sweating, is a danger signal ; there may also be headache, constipation, a tendency to pass urine frequently, and a change of disposition, often shown by irritability and lack of co-operation.

When hyperpyrexia actually develops—which may happen quite suddenly and unexpectedly—the skin is hot and dry and flushed, the pulse is fast and the pupils are contracted : the patient soon becomes delirious and goes into coma (complete unconsciousness) perhaps with convulsions. The temperature may rise to 110° F. or even higher, and death comes soon unless the temperature is speedily lowered. No time must be lost.

Treatment.—The high fever is most easily reduced by the natural method of evaporating water from the skin. To do this, strip the patient, wrap him loosely in a sheet, and spray him continuously with cold water.† Evaporation is helped by currents of air—*e.g.* a fan directed at the patient.

While this is being done, the temperature must be taken every minute. The thermometer should be in the rectum, which gives a more accurate reading than the mouth or armpit. As soon as the rectal temperature falls to 103° F, stop the

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* *Pyrexia* means fever. *Hyper* is the same as *super*, meaning " above " or " over."

† Spraying with cold water is more effective than packing with ice ; for ice by itself is cold enough to make the blood-vessels of the skin contract, and thus lessen the loss of heat.

cooling, dry the skin, and wrap the patient in blankets, with hot-water bottles to the feet and an icebag to the head. Excessive cooling brings risk of collapse from shock. Continue to watch the rectal temperature, and if it rises replace the patient under the cold spray until it falls again to 103° F. In successful cases he will break into a sweat, and recovery will follow; but the heat-regulating mechanism will remain unstable for days or weeks, and precautions must be taken against further attacks.

If cold-water sprays and fans are not available, the patient should be placed in a bath of cold water, with the head supported on a sling, and his body and limbs may then be rubbed, under water, with pieces of ice. As with the spray, great care should be taken not to reduce the temperature below 103° F. At that point the patient should be removed, dried, and kept warm, as already described.

CHAPTER 35

EFFECTS OF COLD

239. Damage may be done by exposure to extreme cold, which causes freezing of the tissues (*frostbite*).

It may also be done by prolonged chilling. Thus, men living for days in flooded trenches, with their legs in mud or water, sometimes develop *trench foot*; and a similar condition is seen in survivors of shipwreck who spend hours in the sea or remain soaking wet in floats or lifeboats (*immersion foot*).

240. Frostbite.—In very cold weather the fingers, toes, nose and ears, and the face over the cheekbones, may be actually frozen: the fluid in the flesh turns to ice. At first perhaps they are only blue or purplish, and at this stage the cold is painful. Then—perhaps suddenly—the pain ceases and the skin becomes white and numb. The man himself may be unaware that he is frostbitten, and in places where there is a risk of frostbite all ranks should make a habit of scanning one another's faces, so that the condition will be recognized promptly and casualties will be prevented.

Provided the part is frozen for only a short time, complete recovery is possible. The danger lies in *thawing*. The cold will have weakened the walls of the blood-vessels; and, if the frozen part is quickly warmed, the fluid plasma of the blood will pour out into the tissues, leaving in the blood-vessels only

a thick sticky fluid which may no longer flow through them. With the tissues waterlogged and the blood-vessels blocked, the circulation of blood is at a standstill. Little oxygen, therefore, will reach the damaged cells, and they will die (*gangrene*).

Hence a frostbitten nose or finger or ear must be warmed only very slowly. To apply any heat greater than that of the body would be disastrous ; so on no account warm the frozen part at a fire or in warm water. The man should not even go into a warm room till first-aid treatment has been given.

Treatment.—Rub the part very gently with your fingers, which may be smeared with a little fat or grease. Or put frostbitten fingers or toes in *cold* water. (Never rub with snow or ice, as formerly recommended.)

As it thaws, the skin softens and goes pink. The aim is to bring it gradually to the temperature of the rest of the body. Contact with warm skin—*e.g.* by slipping a frostbitten hand inside the shirt—may complete the cure.

Prevention.—Regular exercise will promote good circulation of blood throughout the body and thus make frostbite less likely. Clothing must never be tight enough to interfere with the circulation through a limb ; for example tight puttees or knee-breeches would lessen the flow of blood through the toes. Boots should be large enough to take two pairs of thick woollen socks easily ; and for use in extreme cold they should not be greased, because this prevents the sweat from evaporating and the feet will become wet. The feet themselves, on the other hand, can usefully be greased. One pair of socks should be carried inside the jacket, and if possible the feet should be rubbed and the socks changed twice a day. Rubbing is inadvisable, however, if the air is so cold that the feet get chilled while uncovered.

Windproof clothes, fingerless gloves, and caps with ear-flaps are useful preventives.

241. Trench foot.—This condition has two causes: (*a*) poor circulation of blood through the legs ; and (*b*) prolonged chill.

The circulation may be lowered in various ways—by fatigue, by want of exercise, by tight puttees or boots, or by pressure in the bend of the knee when sitting or sleeping on the fire-step of a trench. If the circulation is feeble the leg is more easily chilled ; and the effect of chill is to reduce the circulation further.

Prolonged chilling—*e.g.* by standing in wet slushy mud for hours or days in cold weather—may damage the blood-vessels so that fluid escapes from them and the tissues suffer from lack

of oxygen. Their condition is not as bad as if they had been actually frozen, and the foot is seldom lost through gangrene; but the nerves as well as the blood-vessels may be damaged, and recovery often takes a long time. Also, when the skin becomes sodden and broken, it is easy for germs to enter; and such infection may be dangerous.

Symptoms and signs.—The condition comes on gradually and the early stages may escape notice. In the common form, as seen at the aid-post, the foot is swollen, sometimes enormously; it may be numb but is usually tender and painful, and the skin is glazed and flushed or even purple. Occasionally, however, the foot is pale and cold but not swollen. There may also be blisters.

Treatment.—The patient must be made warm and comfortable but his foot must be kept *cool* or *cold*. The affected leg should be raised, but left exposed to the air. A dusting powder (preferably powdered sulphanilamide) can be applied, but the limb should not be washed. Movement of the toes and feet should be encouraged, but the legs should not be rubbed or massaged at this stage. Hot bottles may be used to warm the patient but must not be put near his legs.

Prevention.—Suitable clothing, good hot meals, and short spells of work help to maintain the circulation. When off duty the men should lie down rather than sit. The feet must be kept as dry, warm and clean as possible, and it is a good plan to grease them.

242. Immersion foot.—This condition is the naval equivalent of trench foot. After about half an hour in cold water the foot begins to get red and numb, and movement of the toes becomes difficult. In three hours or so the limb is a little swollen; and if it remains wet and cold for days, there may be more swelling and blisters and black patches and broken skin.

Treatment is the same as for trench foot. On board ship it will usually be possible to strip the patient of his wet clothes and wrap him in blankets. The damaged feet are left uncovered and are cooled with an electric fan.

Prevention.—In lifeboats men should keep their feet out of water as much as they can, even if they are wearing sea-boots. Dry socks are invaluable, and when socks are soaked it is wise to wring them out and put them on again quickly. If the foot becomes swollen, numb or tender, rubbing will do more harm than good. Boots hinder the circulation in a swollen foot, and it may be best to take them off.

243. Chilblains.—Parts of the skin in certain people, especially the young, become inflamed through exposure to cold and damp. The parts usually affected are the toes, heels, fingers and ears. A chilblain may amount to no more than a slight redness, but sometimes a blister develops and breaks, forming a "broken chilblain." The feet and hands should be kept warm and dry, and protected by gloves and socks. Gentle rubbing in the early stages, and washing the parts with methylated spirit or menthol liniment, is the best treatment. For a blister apply zinc or boracic ointment and cover with lint and cotton-wool. Regular exercise, warm clothing, loosely fitting boots with warm socks, and good food, tend to prevent chilblains.

CHAPTER 36

FIRST-AID ON THE BATTLEFIELD

244. The essentials of first-aid were stated in para. 123, and they are much the same on the battlefield as anywhere else :—

I.—*To prevent immediate death.*—Check hæmorrhage and make sure that the patient can breathe freely.

II.—*To prevent the condition getting worse.*—Cover wounds and burns with dressings ; fix broken bones ; and treat shock by warmth, rest, relief of pain, reassurance and (provided the patient can swallow and the stomach and bowel are undamaged) fluids.

To these rules another must be added :—

III. *To prevent further wounding,* get the patient under cover.

It will usually be advisable to check severe hæmorrhage, and fix a broken leg with splints, before moving the casualty from where he lies. On the other hand, it may be necessary to get him under some sort of cover before attempting any kind of first-aid. A broken limb must be supported, if possible, while he is moved. The risks have to be judged according to the circumstances.

When there are several casualties needing attention, begin with the one that is bleeding most. When one casualty has several wounds, apply the same rule—begin with the one that is bleeding most.

In the field, orderlies will be permitted to use morphine to relieve severe pain. A solution of morphine may be injected

under the skin—*e.g.* from ampoules such as those carried in the first-aid outfit of armoured fighting vehicles—or a tablet of morphine may be placed under the tongue. Anti-infection powders or other substances may be issued for application to wounds or burns before the dressing is put on, and the orderly may also be instructed to give special tablets, by mouth, to all wounded to guard them against germs.

Whenever morphine is given, the time and dose must always be entered on the field medical card.

245. Wounds of the head.—Scalp wounds bleed freely; but, if the underlying bone is uninjured, bleeding from the scalp can be arrested with a firmly bandaged dressing.

If the bone is damaged, a dressing should be applied without pressure. There may be only one wound, where a missile has entered; or there may be both entry and exit wounds. Much bone may be lost, and brain substance may be coming away; but complete recovery may nevertheless be possible.

If the man is fully conscious and has an entry wound only, he may be evacuated sitting. All other cases in which the bone is damaged should be kept lying down with the head on one side to help breathing. Dentures, if worn, should be removed from the mouth and put in the patient's pocket. The wound is covered with a dressing and lightly bandaged.

Depressed fractures (Fig. 54, page 102) are occasionally seen. They may cause compression of the brain, especially by bleeding inside the skull, and unconsciousness. If breathing fails, artificial respiration may be useful.

246. Wounds of the jaw.—Here the great danger is suffocation either by blood clot or by the tongue falling back into the throat. If there is any risk of obstruction of the airway evacuate face downwards (para. 155).

247. Wounds of the chest.—The patient may cough up blood; he has pain in the chest and is short of breath. Signs of internal bleeding may develop later. A through-and-through bullet wound may cause very little shock, but an open shell wound will cause a great deal.

If there is a hole that allows air to be sucked in, it must at once be plugged with a dressing, held in place with adhesive plaster. As soon as possible a medical officer must seal the wound more effectively.

The patient may cough up blood even if there is no external wound; for his lung may have been injured by blast or other violence forcing the chest wall inwards. In these cases, provided there is no reason to think that a broken rib is sticking into the heart or lung, the chest should be supported with flannel bandages (4-inch or 6-inch), firmly applied round it.

The patient should lie down, even if he shows no sign of shock. Raising his head and shoulders may make it easier for him to breathe; but often he will be most comfortable lying on the injured side with the head low. In all these chest injuries morphine is valuable for the relief of pain and discomfort and to control restlessness.

248. Wounds of the abdomen.—Though the hole made by a bullet or bomb fragment may be very small, the missile may have perforated the bowel several times in passing through the abdomen. Serious damage to the abdominal organs may also be caused by missiles entering it through the chest or through the buttock. The abdominal wall may be rigid and there may be vomiting and signs of internal bleeding.

The patient will usually be most comfortable with the shoulders raised and the knees slightly bent, so as to relax the abdominal muscles. He must be kept warm, and should be given morphine if possible, to relieve pain and keep the bowel at rest. On no account should fluids be given by mouth, for even a teaspoonful or two will cause movements of the stomach and bowel.

If a surgical operation cannot be undertaken, the patient's best chance is to lie quite still and take neither food nor drink. A dry mouth may be moistened.

If the bowels are exposed, cover them with a dressing. Never try to put them back in the abdomen. All perforating buttock wounds should be treated at first as abdominal wounds, no matter how small the opening may be.

249. Blast injuries.—The bursting of bombs and shells produces a sudden high wind, travelling away from the explosion. This is immediately followed by suction—like the suction that follows an express train. Thus a person exposed to blast may suffer from the effects of high pressure (impact) or low pressure (suction), or both. His body may be torn apart; or he may be left naked but uninjured; or he may be found dead though apparently unhurt; or he may be collapsed. In serious cases the damage found is hæmorrhage in the lungs, and sometimes other organs, with the usual signs of shock: pin-points of blood may be seen inside the eyelids, and there may also be blood on the lips. The ear-drums are often ruptured.

High-pressure waves will travel through water as well as air, and men floating in the sea after shipwreck are commonly injured by the blast of bombs, torpedoes or depth-charges. The liver and bowel are more often damaged or split by blast transmitted through water than by blast transmitted through air.

The first-aid treatment of blast casualties may be summarized as rest, warmth and morphine, with oxygen later if necessary. Where there are signs that abdominal organs are injured, operation may be needed, and fluids by mouth should be avoided.

250. Shock in battle casualties.—Shock is the same after battle wounds as after other injuries, and treatment follows the rules given in para. 122. Two points should, however, be noted :—

(*a*) Often men who have been fighting suffer from lack of water, and special attention must be given to supplying the wounded with plenty of fluids—preferably with half a teaspoonful of salt added to every pint.

(*b*) Shocked casualties awaiting evacuation will usually benefit if the foot of the stretcher is raised. But not if they have head or chest wounds.

This subject will be dealt with fully in the next chapter.

251. Evacuation.—It is important that the most urgent cases should be sent to the surgeon first. Experience is sometimes needed to decide when delay will be dangerous, but casualties may be roughly divided into three groups as follows :—

Priority 1.—Wounds causing hæmorrhage which continues despite first-aid treatment. Penetrating head wounds. Penetrating abdominal wounds. Penetrating chest wounds in which air is sucked in and out. Open fractures of the lower limb. Severe burns. Tissue wounds larger than the size of two clenched fists.

Priority 2.—Penetrating chest wounds without sucking of air. Open fractures of the upper limb. Fractures of spine. Wounds of the jaw.

Priority 3.—(*a*) The less seriously wounded. (*b*) The dying (*e.g.* head wounds with unconsciousness and a rapid feeble pulse ; abdominal wounds with the bowels out).

Under field conditions it is often impossible to evacuate casualties for hours, or even days, at a time. Skilled attention may also be required at various stages of the journey to the base. From first-aid, therefore, we come to some of the problems arising in the further care of casualties.

SECTION IV.—FURTHER CARE OF CASUALTIES

CHAPTER 37

SHOCK

252. Shock is a state of low vitality following an injury. The injury may be of any kind, mental or physical, including the deliberate injury of a surgical operation.

Shock coming on soon after an accident is called *primary*. Shock which comes on, or continues, an hour or more after the injury is called *secondary*. The signs and symptoms of these two forms of shock are much the same, but their underlying causes differ.

253. Primary shock.—Any injury, great or small, may be quickly followed by symptoms of shock. Severe injuries often cause immediate collapse ; but the amount of shock does not necessarily correspond with the amount of damage, and the man who will faint at a needle-prick may remain unshaken by grave wounds.

This primary or *neurogenic* * shock is a failure of control, and resembles fainting (syncope) produced by bad news or fright. The patient may merely feel weak and giddy, or he may be prostrate and insensible. In collapse his face is pale, his skin cold and clammy, his pulse small and often irregular. These symptoms, however, will usually pass off if he is kept lying down and protected from chill. Pain should be relieved if possible, and reassurance given. Stimulants are also useful, including smelling-salts, ammonia or (for the conscious) tea, coffee or brandy.

254. Secondary shock.—If such symptoms do not yield to treatment, or if they develop more than an hour after injury, the patient is said to have secondary shock. Though this condition is made worse by nervous factors such as pain and fear, as well as by fatigue, cold, and lack of food, its commonest cause is a reduction in the amount of blood in circulation (oligæmia †) : though it may be partly neurogenic, it is mainly *oligæmic*.

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* *Neuron* is the Greek for a " nerve," and neurogenic means " originating through the nervous system."

† From the Greek *oligos* (little) and *haima* (blood).

Oligæmic shock arises from actual damage to the tissues of the body. The amount of fluid in circulation may be reduced because blood has been lost by hæmorrhage; or the fluid part of the blood (the plasma) may have oozed out of the blood-vessels in damaged tissues. When, for example, a limb is crushed or a bone is broken, several pints of plasma may exude into the bruised and torn muscles; and surprisingly large quantities seep away from the surface of burns. Such loss of plasma, though less obvious, is actually more harmful than hæmorrhage, because the remaining blood, which retains all the cells, becomes thick and sticky and is harder to circulate.

After loss of fluid from the blood-vessels the heart may go on beating energetically, but its chambers may not fill completely between contractions and it will then be less efficient as a pump. If the heart does not fill properly, the stream of blood entering the arteries at each beat will be smaller and less forceful than usual; its pressure will be lower.* In most people the systolic blood-pressure is 120 mm. Hg or more (which is a short way of saying that the pressure of blood in the arteries at the moment of systole, when the heart is pushing blood into them, is at least sufficient to support a column of mercury 120 millimetres high). In oligæmic shock, when much fluid has gone out of circulation, the systolic pressure may drop, quickly or slowly, to 70, 60, 50 or even only 40 mm. Hg. An additional cause of this fall in blood-pressure—which is very dangerous—may be the absorption of poisonous substances from damaged muscle or infected muscle (*e.g.* gas-gangrene).

The symptoms of shock arise partly from the lowering of pressure and partly from the efforts made by the body to counter it. If the pressure falls too far, the brain will go short of oxygen; and to prevent this happening the body reduces the bore of most of its smaller arteries and thus cuts down the supplies to less vital organs. The skin, no longer receiving its usual quantities, is pale and cold (though damp with sweat) and the nails, lips or ears are bluish. The temperature falls. The lack of fluid induces thirst and a dry tongue. The heart, in trying to maintain an adequate blood-flow, often beats very fast, though feebly, and the pulse may thus be rapid. Consciousness is sometimes impaired, but the patient may be mentally alert even when moribund. He is restless and liable to vomit the fluids given him.

These symptoms are, as would be expected, the same as

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* Compare the effects of squeezing a rubber ball containing water. With equal compression the jet is much stronger when the ball is full than when it is half empty.

those following a severe hæmorrhage; for profuse bleeding brings on oligæmic shock in its simplest form. They may also be seen after surgical operations. But shock in battle casualties is usually complicated by the effects of exhaustion, exposure, thirst, pain and mental stress—all of which must be considered in prevention and treatment.

255. Prevention and treatment of shock.—To prevent or reduce shock the seriously wounded or injured require :—

(*a*) *Arrest of hæmorrhage.*

(*b*) *Warmth.*—Waterproof sheets and blankets should be carried by all stretcher squads. If blankets are not available, protective clothing should be placed between the canvas and the patient rather than on top of the patient. If the dressing-station is cold, some means of warming stretchers should be improvised.

(*c*) *Relief of pain :* (i) by efficient splinting of fractures, which will also reduce plasma-loss by limiting movement of the fragments; and (ii) by sedatives such as morphine. Shocked patients need very gentle handling and quiet.

(*d*) *Reassurance.*

(*e*) *Fluids by mouth.*—ALL wounded, except those who are unconscious or may have wounds of the stomach or bowel, should get plenty of water; or, better still, warm sweet tea or coffee. They will need at least 6–8 pints in the first 24 hours; and at medical posts or halting-places small pails should be set beside their stretchers, with rubber tubes through which they can suck water. (Avoid siphon action and possible choking by ensuring that the level of the fluid in the pail is below the level of the patient's mouth).

It is an advantage to add salt to all drinks (half a teaspoonful to the pint).

(*f*) *Evacuation.*—Pending evacuation the stretcher should be raised about 9 inches at the foot end, except in cases of head or chest injury, when it should be kept horizontal. During evacuation, and whenever the patient is moved, care must be taken to prevent unnecessary jolting.

As soon as possible more elaborate measures of resuscitation (revival) must be undertaken. Their object is to ensure that nobody dies of shock who might recover from his wounds. The shock may well be more dangerous than the injuries, and

if the patient is made fit enough to withstand operation more than half the battle is won.

Wet and dirty clothes are removed and the patient is put into warm pyjamas and blankets. Even if he vomits occasionally, he should be coaxed and pressed to drink as much as he can ; and in resuscitation wards orderlies may be detailed to see that fluid is offered frequently. Hot bottles or special apparatus may be used to bring the body heat back to normal ; but over-heating to the point of sweating must be avoided. The head-low position is maintained except in head and chest cases.

Lastly (but most important), in all cases with low blood-pressure, and in all cases with recent injuries that must have caused great loss of blood or plasma, injection of fluids will be needed to restore the blood-volume quickly.

In oligæmic shock the body itself tries to restore the blood-volume by withdrawing fluid into the blood-vessels from the tissues (muscle, skin, etc.). But this process of draining the tissues in order to keep up the pressure in the circulation does not begin to have much effect until several hours have passed ; and after serious loss of blood these tissue reserves may not come into action soon enough, or in sufficient quantity, to save the patient. The tissues of most wounded men, especially in the tropics, are already in a thirsty state in which they want to absorb water rather than give it away. This state of dehydration can be partly prevented or gradually cured if the patient is able to take plenty of water (preferably salted) by mouth. But by injecting blood or other fluids into the veins it is possible to do quickly what Nature can do only slowly, if at all—namely, to put back enough fluid into the circulation to raise the blood-pressure immediately to a safe level and keep it there.

256. Blood transfusion.—To maintain the blood-pressure at a higher level, it is necessary to inject a fluid that will *stay* in the circulation ; and in the early stages of shock, before the tissues have been drained, blood and blood-substitutes, such as plasma and serum, are far more efficacious than saline or other solutions which are rapidly absorbed into the tissues or excreted.

Plasma is blood from which all cells have been removed, and it can be dried into a powder which is made ready for use at any time by adding distilled water. Serum, which can likewise be dried, is the liquid left over when blood is allowed to clot. If several pints of fluid have to be injected, it is best that some of it should be " whole blood " ; but this is not essential, and for most cases of shock plasma is almost as good as blood ; while for burns it may be better. Dried human

plasma and serum will keep indefinitely in any climate and can be injected into anyone, without preliminary tests. Whole blood is less convenient because it must be stored in a refrigerator and will seldom keep longer than about a month. Also a grouping test is always necessary, at some stage, to find out whether it will mix satisfactorily with the blood of the patient.

If blood from an animal is injected into the veins of a human being, the cells may clump together in masses, or be destroyed, causing acute illness or even death. The same thing may happen on combining the blood of two human beings who belong to different blood-groups. Hence, before a blood transfusion is given, the group of one or both parties must be known with certainty: indeed it is best, if time permits, to test their mixing qualities directly on a slip of glass (cross-matching).

A person's blood-group is a hereditary characteristic, like the colour of his eyes, and does not change. There are four main groups, known as AB (I), A (II), B (III) and O (IV). People in group O are called " universal donors " because their blood, like plasma or serum, can safely be injected into anybody; while those in group AB are " universal recipients " because they can safely receive anybody else's blood. A grouping test, however, reveals nothing more than the mixing properties of the blood, and medical officers selecting donors for whole-blood transfusion must take other steps to make sure that they are free from infections, such as syphilis or malaria, that might be transmitted to the patient. Plasma and serum do not carry this risk, for during preparation they go through filters that remove bacteria and similar organisms.

The amount of blood ordinarily taken from donors is about a pint, which is roughly a tenth part of the average quantity in circulation. Most people have a surplus over their immediate requirements, and are unaffected by temporary reduction of their reserve. Removal of one pint takes only a few minutes, followed by a brief rest. The injection into the patient, on the other hand, is often made very slowly; for blood and other fluids may be most beneficial if they are passed into the veins continuously over many hours. Slow " drip transfusion ", from a bottle hung above the bed, may be continued during operations and during sleep.

257. Dehydration.—In para. 255 the importance of fluids in first-aid has been emphasized. In battle the soldier often goes short of water and sweats freely. He may be wounded at a time when he already needs water, and he may then lose much fluid through hæmorrhage, exudation, vomiting and further sweating. Often he will get no attention for many

hours. When he is picked up he may be given morphine to relieve his pain, and this will take the edge off his thirst. Or he may be too weak to make the effort of drinking. In this way, within a single day, a man may become gravely ill from lack of fluid, quite apart from the effects of his wounds.

When the shortage of fluid in the body reaches 7–10 pints, the mouth will be dry and little urine will be passed. When the deficit rises to 12–16 pints, the blood-pressure will be low, the pulse feeble and the colour bluish. These symptoms due to dehydration (lack of fluid in the tissues) may be mistakenly put down to oligæmic shock (lack of fluid in the blood-vessels). Very often, however, the two conditions exist together, and dehydration adds to the danger of shock because the blood cannot draw from the thirsty tissues the fluid it needs to restore its volume and pressure to a safe level.

As natural recovery from shock is achieved by draining fluid from the tissues into the blood-vessels, it is easy to see that severe cases which survive for many hours without treatment may pass from a state of shock into a state of dehydration. When a severely wounded man arrives at a hospital or dressing station many hours after wounding he may no longer need an injection of blood or plasma to support his circulation, but he will almost certainly need water and salt to restore fluid to his tissues.

Copious drinks, though they have little immediate effect on the blood volume, are quickly absorbed by dehydrated tissues, and in very weak patients the same result can be secured by slow infusion of saline solution into a vein.

For the *prevention* of dehydration, all wounded—except those who are unconscious and those whose stomach or gut may have been perforated—should have ample quantities of water, or tea or coffee, as described in para. 255. Half a teaspoonful of salt is added to each pint, because dehydrated tissues lack salt and will absorb water more readily if salt is supplied with it. Unsalted water is more likely to find its way out through the kidneys.

258. Shock and fear.—In thinking about fluid in the tissues and fluid in the blood-vessels, and hæmorrhage and wounds, it must not be forgotten that the patient has a mind as well as a body. Neurogenic shock, due to failure of nervous control soon after the accident, may pass off quickly or may never be apparent, and oligæmic shock developing later is far more dangerous to life. But even in oligæmic shock survival does not depend entirely on the precise number of ounces of blood or plasma injected. Success or failure may turn on factors that cannot be measured, such as hope and faith and will on one side, and fear on the other.

Fear weakens a patient and lessens his chance of recovery. Serious wounds are almost bound to make a man feel either apathetic or afraid, and at first sight it may seem that an orderly can do little to change such states of mind. Actually, however, the wounded and the sick are often abnormally responsive to the influence of those around them. Rough or careless handling, unfriendly service, or a thoughtless remark at the bedside, easily reduce them to gloom in which their fears take control. On the other hand, a kind word, an atmosphere of cheerful confidence, gentle management, and occasional reassurance may work miracles by bringing back hope and courage.

Each in his own sphere, and in his own way, the stretcher-bearer and the orderly must cultivate some of the qualities of the good nurse.

CHAPTER 38

WOUNDS AND BURNS

259. Different kinds of wounds.—Wounds differ greatly, according to their cause.

Incised wounds, or cuts, may be made with any sharp instrument. They bleed freely because the blood-vessels are cut cleanly and the edges tend to separate ; but the edges are not bruised, and healing will therefore be rapid if infection by germs is avoided.

Lacerated or contused wounds are caused by blunt instruments, by machinery, or sometimes by bullets and bomb fragments and "secondary missiles" such as stones thrown up by an exploding shell. There is less hæmorrhage than in an incised wound, for the arteries tend to be torn irregularly, and the crumpled torn ends hinder the flow of blood. But wounds of this kind usually gape, and the crushed flesh easily becomes infected. Early removal of any hopelessly damaged tissues by a surgeon is necessary.

Punctured wounds, or stabs, may be made with any form of penetrating weapon, from a needle to a bayonet or a bullet. The wound is small on the surface but may be deep. External bleeding is seldom severe and is readily controlled. Nevertheless these wounds are dangerous because an internal organ, or a deep artery, may have been cut, and because germs conveyed by the weapon or missile into the depths of the wound cannot be removed at all easily. Certain germs, such as those of tetanus (lockjaw) grow best where there is

no air, and a punctured wound provides the conditions they need.

Gunshot wounds include all varieties of injury caused by bullets, shells, bombs and grenades.

Wounds caused by rifle and machine-gun bullets may be :—

(*a*) Tangential—a graze of the surface.

(*b*) Penetrating—where there is only a wound of entry and the bullet lodges in the tissues.

(*c*) Perforating—where there is a wound both of entry and exit. If the bullet passes only through soft tissues, both wounds may be small; but if the bullet strikes a bone, not only is this usually fractured but the exit wound may be very large and irregular. Generally speaking, the exit wound is larger than the entry wound; but bullets fired at close range often cause large entry wounds, and so do spent bullets and those that ricochet.

The tangential bullet wound, being on the surface, requires merely routine treatment. With a penetrating wound, operation for removal of the missile is nearly always needed. The clean perforating wound usually heals readily with simple treatment; but if there is a large exit wound an operation is necessary.

Shell wounds, and those caused by bombs and grenades, are very variable in character. The small fragments of a high-explosive shell may cause ordinary punctured wounds: on the other hand, large irregular slow-moving shell fragments cause severe lacerated wounds, and may even take off an entire limb. Fragments usually lodge in the body; they often carry pieces of clothing into the wound with them; and the wounds are nearly always infected by germs.

260. Treatment of wounds.—A sterile dressing is applied as soon as possible (*a*) to check hæmorrhage, and (*b*) to prevent the entry of germs. In first-aid no attempt should be made to clean the wound or the surrounding skin. Special powders or other substances preventing infection may, however, be issued for application to the wound before the dressing is put on.

If the wound is large it is often beneficial to use a sling or splints to keep the wounded part at rest, even though no bones have been broken. Treatment for shock will be required.

All large wounds need operation—within 12 hours if possible. The surgeon will cleanse the wound by removing (*excising*) all tissues which have been crushed and are hopelessly damaged, and will usually extract " foreign bodies " such as bullets, or fragments of metal or stone or cloth. Dead flesh makes an

ideal bridge-head for invasion by germs; they multiply fast in the damaged tissues and thence attack the living tissues around them. By cutting out the damaged tissue the surgeon much reduces the chance of any serious infection. If he is sure that the wound is clean and that germs have no chance of multiplying in it, he may close the wound by sewing up the skin over it (*suture*). Otherwise he leaves the wound open, or partly open, lest infected matter (*pus*) should form inside it. Infection is more likely to be harmful if the wound is closed than if it is left open so that pus and other infected fluid can drain away.

To secure rest for the wound, enabling it to heal, the surgeon often encloses the whole area in plaster-of-paris. When dry this forms a well-fitting splint, and the method is particularly valuable where the patient, after operation, has to be evacuated to a distant hospital. The plaster allows him to be moved with relatively little pain or interference with healing.

When wounds are heavily infected it is sometimes thought advisable to keep them clean by irrigating them with fluids that prevent the growth of germs. Tubes can be put into the wound in such a way that fluid drips into all its recesses.

261. Healing of wounds.—An infected wound heals slowly and leaves a large irregular scar. To get a wound to heal quickly and painlessly, it must be sterile.

In a clean incised wound, when the surfaces are brought together, the blood clots and causes the surfaces to stick to one another. Gradually new cells grow from each side into the clot. The latter is partly absorbed and partly replaced by cells of fibrous connective tissue. Often the surfaces are united in a week. This is called "healing by first intention."

If there is much destruction of skin or flesh, the sides of the wound cannot be brought together. The raw surface soon becomes covered with minute soft red projections which bleed easily. These contain the growing blood-vessels and are known as *granulations*. They may continue to increase until the cavity of the wound is almost filled, and then the skin grows in from the edges until the wound is healed. This often leaves a large scar and it is a slow process. It is called "healing by granulation."

262. Burns.—A burn, as explained in para. 179, is a special kind of wound. The first-aid treatment is essentially the same as for other wounds—namely to cover the damaged area with a sterile dressing and treat for shock. In burns, however, there is no hæmorrhage, and the immediate danger is shock. In severe cases treatment for shock—especially the relief of pain, if that is possible—is more urgent than attention to the burn.

Shock is the commonest cause of death from burns. At first it is mostly due to pain (neurogenic shock) which can be relieved with morphine. But if much fluid oozes into the burnt areas the volume of blood in circulation may fall rapidly and the patient will remain collapsed (oligæmic shock). Infusion of plasma into a vein is invaluable in this second form of shock, because it replaces the kind of fluid the body has lost.

Surgical treatment consists in cleansing the surface of the burn very carefully so as to remove all germs, together with charred skin and adherent pieces of clothing. To be thorough this must usually be done with the patient under an anæsthetic. After cleansing, various different remedies can be applied. Some are intended simply to keep the raw surface free from infection, which seriously delays healing: others, by coagulating the damaged tissues, form a " skin " over the burn, which reduces the outflow of fluid and also prevents absorption of poisonous substances that may be formed in the damaged flesh.

If only the surface of the skin has been burnt, healing may be rapid, even if the area is large. But when the whole thickness of the skin has been destroyed, healing is by granulation and is slow. In such cases care must be taken that the large scars which result from deep burns do not fix the joints: for example, the fingers may be left bent in such a way that the hand is almost useless. To prevent disasters of this kind, burnt limbs are often supported with splints or in plaster-of-paris. Grafting operations may be needed later to cover a bare area with skin or to restore its shape.

CHAPTER 39

ANTISEPSIS AND ASEPSIS

263. Germs.—Bacteria belong to the lowest grade of vegetable life, and are so small that they cannot be seen except with a powerful miscroscope. They multiply by dividing into two, and they divide so often that a wound invaded by one or two bacteria may in a few hours contain many millions. The words " germ " and " microbe " cover all the many kinds of bacteria and similar minute organisms—vegetable or animal—that may be found in the human body.

Distribution.—Germs exist everywhere: they are found on the skin (particularly when it is dirty), in the air, and in the ground. Nothing can be regarded as free from them, unless it is sterilized.

Conditions of life.—Most germs are not concerned with human beings except by accident, and nearly all of them can live outside the human body—often for a long time A good many varieties, however, if they happen to enter a wound where warmth and moisture are provided, find conditions exactly to their liking and may multiply very rapidly. As they grow, they produce poisons (*toxins*) which escape into the blood-stream, causing fever and even death. Some kinds of germs, such as those of tetanus and diphtheria, produce very potent toxins.

264. Action of germs in the body.—When germs are implanted in a wound several things may happen :—

(*a*) If few, they are attacked and soon destroyed by the body fluids and white cells of the blood (para. 42). The wound heals quickly without pain.

(*b*) If the germs are more numerous or more virulent, a battle is joined. More blood is rushed to the part to help in defence. The wound becomes red, swollen, hot and painful. This is known as *inflammation*.

(*c*) If the defences are endangered, many of the white cells are killed, and their dead bodies, floating in fluid plasma from the blood, forms the milky or creamy fluid known as pus. This process is known as *suppuration*, and is accompanied by increased pain, swelling, and a swinging temperature. When the pus collects in one place it is called an *abscess*.

(*d*) If the germs are powerful enough to overcome the local defences of the body, they may enter the blood-stream, and spread over the body. This general " blood-poisoning " (*septicæmia*) may cause death.

265. Sepsis and asepsis.—The entry of germs into a wound is called *infection*, and the condition caused by their multiplication in a wound is called *sepsis*—a word which originally meant " rotting " or " decay." In a septic wound the germs are well established, and it is by no means easy to clear them out again. Hence the first aim in treating wounds is always to prevent infection.

Modern surgery owes its success largely to *aseptic methods*,* designed to keep germs out of the area of operation. Whenever an operation is performed, everything that may come in contact with the wound is previously *sterilized* (rendered germ-free). This applies not only to the instruments, but to

* Asepsis is the opposite of sepsis. It has come to mean " absence of germs."

bowls, towels, swabs and the rest of the surgical equipment. The patient's skin in the field of operation is sterilized; the surgeon wears a sterilized gown and sterilized rubber gloves, and puts on a mask and cap to prevent germs from his mouth, nose or hair falling into the wound.

Similar precautions—though they are usually less elaborate—are taken in dressing wounds. Even if a wound is already septic, great care must be taken to prevent fresh bacteria getting into it, for they may make the condition far worse.

266. Destruction of germs.—Germs are readily killed by heat. The usual method of sterilizing dressings, towels and gowns is to heat them in a special sterilizer called an *autoclave*, while rubber gloves and many other articles can be boiled. But heating is not always suitable or possible, and for certain purposes one must rely on *disinfectants*, which are powerful chemicals able to kill germs quickly, and on *antiseptics*,* which are similar but weaker chemicals that can be applied to the skin or tissues without harming them seriously.

The difficulty has always been to discover antiseptics which will kill germs but will not hurt the delicate cells of the body, and great advances have lately been made in this direction. Chemical substances such as the sulphonamides are capable of stopping the multiplication of germs in the blood, or in a wound, without doing harm to the tissues, and other substances (such as penicillin) with a similar beneficial action are coming into use.

267. Disinfectants.—These are usually employed when the article to be sterilized is too large to be baked or boiled, or might be damaged by such treatment; for example, the cutting edge of surgical knives and scissors is blunted by frequent prolonged boiling. Disinfectants in common use include :—

For cutting instruments.—Pure carbolic acid; pure Lysol (a solution of cresol in soap); "antiseptic fluid" (chloroxylenol). The instruments must be clean before immersion, or sterilization may be incomplete.

For baths, bowls, etc.—Pure Lysol.

For rubber sheets and fabrics.—Lysol or Dettol ($\frac{1}{2}$ oz. per pint of water).

Tables, trolleys, etc.—Lysol or cresol (1 oz. per pint of water).

Sinks, drains, etc.—Cresol ($\frac{1}{4}$ oz. per pint of water).

There are many commercial disinfectants similar to cresol, such as Izal, Cyllin and Jeyes' fluid. They are stronger but more expensive.

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* Antisepsis means "against sepsis."

Being powerful chemicals, most of these disinfectants are poisonous when swallowed, and some of them will burn the skin as well as the mouth and stomach.

268. Antiseptics.—The only difference between a disinfectant and an antiseptic is that antiseptics are intended for application to the body tissues and must not be strong enough to injure them. This means that they are not always strong enough to destroy bacteria, and they may act rather by hindering their growth than by killing them. Some antiseptics are disinfectants suitably diluted; for example, carbolic acid at full strength is a disinfectant which burns the skin; but a 1 in 20, or 5 per cent., solution (1 part of carbolic acid with 19 parts of water) is often employed as an antiseptic.

The main uses of antiseptics are :—

(*a*) To disinfect the skin before an operation, or the skin around a wound.

(*b*) To cleanse a mucous surface (*e.g.* as a mouth-wash or gargle).

(*c*) To sterilize a fluid. For instance, if it is necessary to bathe a wound with water, the addition of an antiseptic makes the water safer.

Their use in open wounds is limited. If a wound is small and superficial the early application of a non-irritating antiseptic, such as Dettol, helps to remove germs which may have lodged on it. But in large and deep wounds, where germs tend to be buried in the walls, ordinary antiseptics have little chance of success and are apt to cause further damage to the injured tissues. It must be remembered that the body is provided with its own means for dealing with infection (paras. 42 and 44), and this must not be interfered with.

The following are antiseptics often employed :—

To sterilize the skin.—Tincture of iodine (2 per cent. in spirit); picric acid (3 per cent. in spirit); Dettol (undiluted); carbolic acid (5 per cent. in water).

To cleanse a mucous surface (such as the throat).—Carbolic acid, 1 in 20 (5 per cent.); hypochlorous acid, usually in the form of eusol, but Milton and other proprietary antiseptics contain it. (Carbolic acid and hypochlorous acid are usually diluted with about four parts of water before use).

Boracic (boric) acid, a weak but non-irritating antiseptic, is suitable in 2 per cent. solution for the eyes. Permanganate of potash (diluted to 1 in 1,000, or weaker) forms a wine-coloured fluid which has been much used for irrigating the urethra in gonorrhoea.

To sterilize a fluid used for irrigation of a wound, or bathing an inflamed part.—Carbolic acid, 1 in 20; perchloride of mercury, 1 in 1,000; eusol; Dettol. (Eusol may also be used in full strength for irrigating or bathing wounds).

Almost any antiseptic will serve this purpose, for only a small quantity is added to each pint of warm water.

For application to a small surface wound.—Acriflavine, 1 in 1,000; Dettol, 1 in 5; eusol, 1 in 5.

Though not really an antiseptic, magnesium sulphate (Epsom salts) can usefully be applied in concentrated solution to unhealthy surface wounds (*ulcers*). The strong salt solution draws fluid out of the wound, and though the treatment is painful it will sometimes make a wound clean and healthy within a short time.

CHAPTER 40

DRESSING OF WOUNDS

269. In dressing a wound two things must be kept constantly in mind :—

As little pain as possible must be caused.

Every endeavour must be made to keep germs out of the wound, even if it is already septic.

270. Comfort to the patient.—Only enough bedclothes should be removed to give a thorough exposure of the wound, and only one wound should be uncovered at a time. A badly damaged limb should be supported by an assistant while the dresser undoes the bandage, and care must be taken not to lean or press on the patient. Gentleness is necessary in all contact with the wound. If the dressing is stuck, it must be thoroughly moistened before removal. Hydrogen peroxide is useful for this and is mildly antiseptic.

271. Exclusion of germs.—The wound may be contaminated by dust in the air of the ward; or droplets from the mouths and noses of those at the bedside while the wound is exposed; or contact with soiled fingers, instruments, dressings and lotions. The following rules should therefore be observed :—

(*a*) If possible, dressings should not be done within an hour of bed-making or dusting of the ward. These increase the number of germs in the air by raising dust. Windows and doors should be kept shut during the dressing.

(*b*) If an orderly suffers from a sore throat or a septic sore on the hands, he should report it at once: both are a danger to patients. Masks may be worn to prevent infection from the nose or mouth. If they are not available, care must be taken not to cough or talk over an exposed wound.

(*c*) Before starting to do dressings everything should be got ready on a trolley. Sterile dressings are either in a " drum " or packet, and sterile dressing forceps are put in a dry sterile dish. The long Cheatle forceps used for handling dressings (Fig. 69) are usually placed in a jar of antiseptic, the handles remaining outside. Safety-pins and clean bandages are placed on the lower shelf of the dressing trolley. Two bins or buckets should be available for discarded dressings; one to receive bandages and wool which can be used again, and one for dirty dressings which will have to be burnt.

(*d*) During a dressing the hands must not touch the wound, the skin around the wound, the inner dressing (or anything beneath it), sterile materials or sterile lotions, or the inside of sterile bowls or dishes. (As an additional precaution it is wise to dress clean wounds first and septic ones later.)

272. Procedure.—To carry out dressings satisfactorily, two persons are needed: (*a*) a dresser, who takes off bandages and dressings and attends to the toilet of the wounds; and (*b*) an assistant, whose sole duty is to look after the trolley and pass clean things to the dresser.

At the start of the round of dressings, both dresser and assistant put on masks and gowns; the assistant washes his hands in soap and water and dries them on a clean towel.

The dresser turns back the bedclothes gently without raising dust; he arranges the patient in position, takes off the bandages and outer dressings, and places them in the salvage or destructor bin, according to their condition. He then washes and dries his hands.

From this point all the work is done with sterile forceps. The hands never come in contact with :—

the wound or the skin round it,
soiled or clean dressings,
sterile lotions, bowls or dishes.

The dresser, using forceps, removes the inner dressing and drops the soiled materials into the destructor bin or bucket. If desired, a sterile towel, passed to the dresser by the assistant, is laid near the wound as a convenient rest for dressings and instruments.

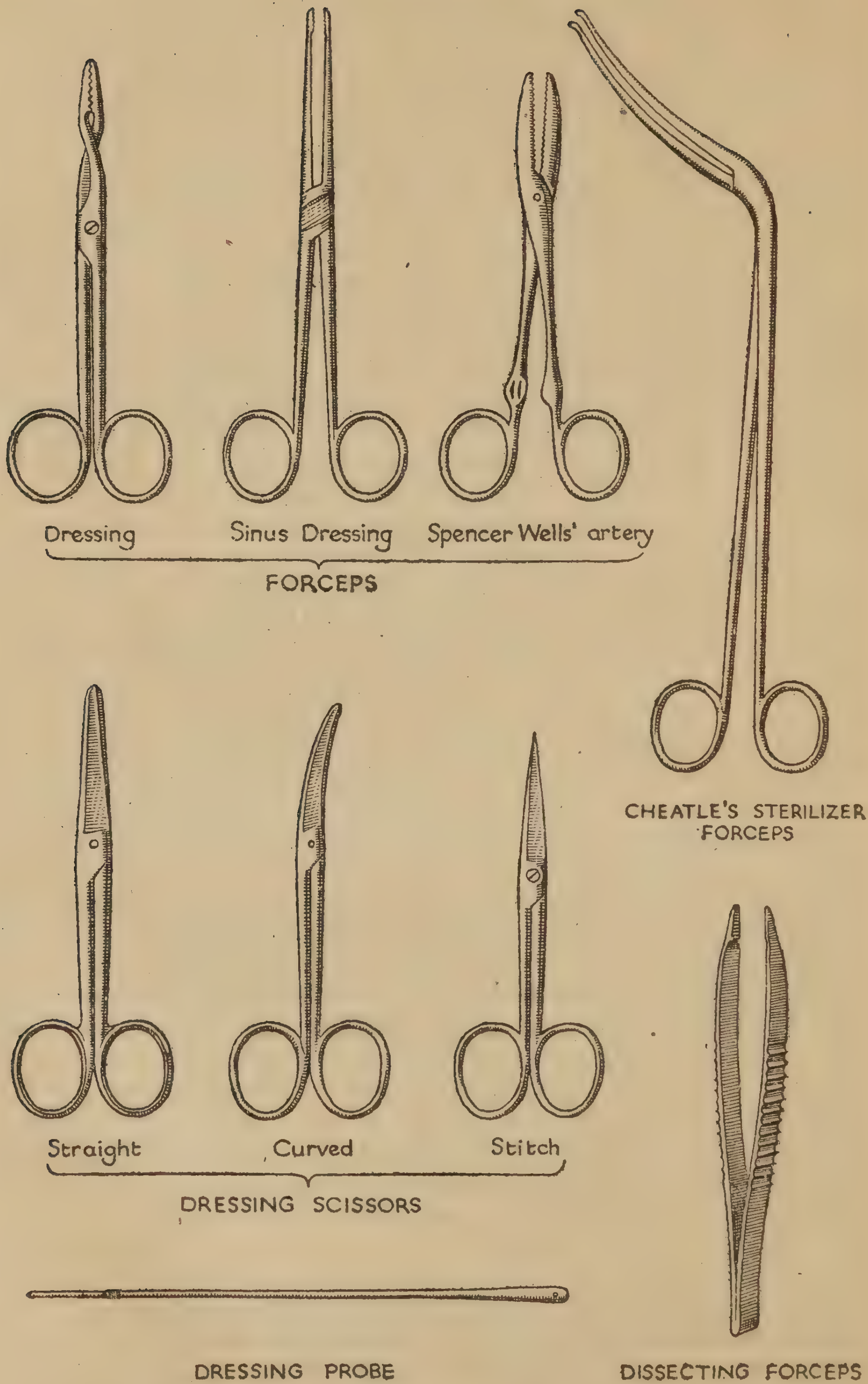

FIG. 69.—FORCEPS AND SCISSORS.

The assistant opens the dressing package, or, if large drums are used, places the necessary dressing material in a sterile dish.

Using two pairs of forceps, the dresser cleans the skin around the wound ; he then performs the necessary toilet (removal of stitches, drains or packing and irrigation), and covers the wound with a sterile dressing. Great care must be taken to fix the dressing so that it cannot slip.

All sterile material needed by the dresser is passed to him by the assistant with forceps (Cheatle forceps) which never touch anything that is not sterile. Particular care must be taken that the forceps of the dresser *never* touch those of the assistant.

The dresser then discards his forceps for re-sterilization * and applies the outer dressing and bandages.

Details of procedure will vary in different hospitals, and on active service in the field modifications may be inevitable. But it is important that everyone concerned in the dressing of wounds should understand the general principles.

273. Use of fluids during dressing.—Mention has been made of the need to soak off an adherent dressing. This must not be done by squeezing moistened swabs with the fingers. Either a syringe should be used, or better still, a large bottle with two holes in the cork, through which pass a long and

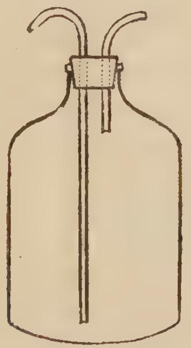

FIG. 70.—BOTTLE USED IN REMOVING DRESSINGS OR IRRIGATING WOUNDS.

short glass tube (Fig. 70). The whole is sterilized and filled with sterile solution. For use it is inverted and the fluid runs out of the shorter tube ; the longer tube is merely an air inlet. This simple apparatus can also be used for washing out (irrigating) a deep wound.

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* Instruments after use must be scrubbed with soap and water and then boiled for 5 minutes. The Cheatle forceps, used by the assistant only for handling sterile instruments and dressings, do not require re-sterilization.

CHAPTER 41

FRACTURES AND HEAD INJURIES

274. Evacuation of fracture cases.—In first-aid the broken bone is fixed by splints or bandages to prevent the fragments from moving about. In this way pain is reduced, and there is less risk of collapse from shock. When the fragments are held fast, their sharp broken ends will do no further damage to soft tissues such as muscles and nerves and blood-vessels.

If the fracture is open (compound), the wound leading down to the bone has to be protected from infection, and is therefore covered with a sterile dressing. Whenever the injury is at all serious the patient must be kept warm and should have plenty to drink to guard him against oligæmic shock. In the field morphine will probably be given to relieve pain.

During evacuation of fractures the chief dangers are shock, bleeding (if the fracture is open), and swelling under the bandages. Certain forms of infection, by germs entering through a wound in the skin, cause rapid swelling which needs immediate surgical treatment; but even with a closed (simple) fracture, in which the skin is undamaged, the tissues around the broken bone may swell considerably.

Any patient who complains of pain must be carefully examined—preferably by a medical officer—to make sure that swelling has not made his bandages too tight. Loosening of bandages may not only save him from torment but also may save a fractured limb from permanent damage. A tight bandage acts like a tourniquet in reducing the circulation through the limb, and it may have the same disastrous effects as a tourniquet which has been left too long in place.

275. Treatment at the operating centre.—Before operation can be attempted, the patient must be fit to withstand it. To restore his strength, he may need rest and warmth and a transfusion of blood or plasma.

As soon as his general condition is good enough, the fracture is re-examined, and if the bones are not in the best possible position for healing they are " set " again by the surgeon. An anæsthetic of some kind is usually given to prevent pain and to relax the muscles so that the bones can be brought into their proper place.

If the fracture is open (compound), the wound is explored; the surgeon removes foreign bodies such as bomb splinters and shreds of cloth, and also any detached bits of bone which could not live. As with all wounds, he carefully cuts away all

crushed muscle or other dead tissues that would give a foothold to germs. This should be done if possible within twelve hours of wounding. Various preparations can be put in the wound to combat sepsis; it is then covered with a sterile dressing, such as gauze steeped in soft paraffin to prevent it sticking to the flesh.

Before the influence of the anæsthetic has worn off, the bones are brought into their normal alignment and secured with fresh splints or in some other way. When a Thomas splint has been used in first-aid, the surgeon will often replace it by another Thomas splint with a smaller ring; and instead of the Millbank clip, or clove-hitch halter, which kept the limb extended, he may apply adhesive strapping to the leg, or may even attach his extension bands to a metal pin or wire driven through the tibia.

Many fractured limbs are encased in plaster-of-paris, which forms a hard protective shell and prevents movement during long journeys over bumpy roads or rails. A shell of this kind is made from muslin bandages which have been impregnated with the plaster in powder form; after soaking in water the bandages are applied closely to the limb, and, as it dries, the plaster sets hard. Useful splints can also be prepared from a slab of wet plaster bandages—many layers deep—moulded on the limb while it is still soft. When dry, this splint is readily removable, and is fixed with ordinary bandages in the usual way.

Other kinds of splint are made from plastics and from wire. Cramer's splinting is a ladder-like arrangement of wires which can be cut with strong pliers and bent as required.

276. Mode of repair of bones.—A bone has its blood-vessels, just like any other portion of the body; it must not

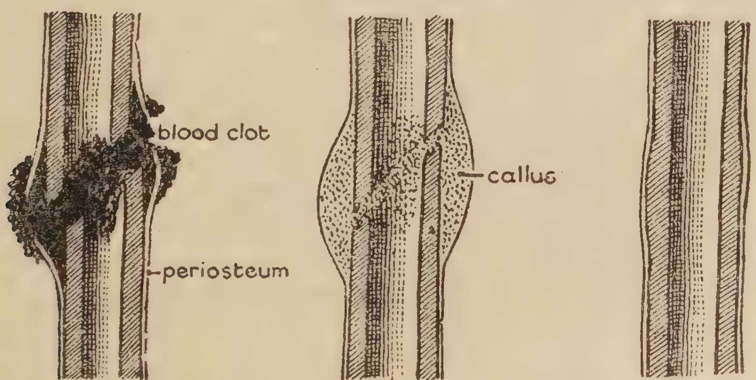


FIG. 71.—HEALING OF BONE.

be looked upon as a hard bloodless structure, but as a portion of the living body which is itself alive. The blood which escapes at the time of the injury sets into a jelly-like mass,

which in time is formed into new bone. This soft mass which surrounds the broken ends of the bone and is going to become bone is called *callus* (Fig. 71), and in hardening it holds the ends together. In the course of months a large portion of the callus at first formed becomes absorbed, and eventually there may be very little to show where the fracture has been.

To allow repair to proceed naturally, the broken ends of the bone should remain completely at rest. Nature attempts to ensure this by causing pain when the limb is moved, and the surgeon assists Nature when he fixes the limb in splints or takes other steps to prevent the ends of the bones from moving.

277. Head injuries.—In describing first-aid for head injuries (paras. 153 and 190) it was pointed out that compression of the brain, usually caused by bleeding inside the skull, may develop some hours after the head is struck. For this and other reasons, all head injuries—no matter how slight they may appear—should for the first 48 hours be regarded as serious. The patient should be kept in bed with his head low and not allowed to read or exert himself in any way.

Concussion is sometimes followed by a state of *cerebral irritation*, shown by great irritability of mind and body. The patient lies on his side with all the limbs bent, the back arched and the knees drawn up to the abdomen. He is restless and may toss about the bed ; the eyes are closely shut, the pupils contracted and the temperature raised. The pulse is quick but weak. He is not unconscious, but he resents being spoken to or disturbed ; and he must be carefully watched lest he should get out of bed.

Symptoms of *compression* may be caused not only by blood from an injured blood-vessel but also by collections of pus (abscesses) or pieces of bone pressing on the brain. As explained in para. 190, an operation will probably be needed to remove the blood clot or bone or to drain the abscess.

Gunshot wounds of the brain are by no means always fatal, and even when brain substance has been lost the patient may recover completely. When missiles lodge in the brain, they can often be removed by the surgeon ; but, even when they are left in place, they do not necessarily do any harm.

SECTION V.—CHEMICAL WARFARE

CHAPTER 42

EFFECTS OF WAR GASES AND THEIR TREATMENT

278. Classification.—The war gases are broadly classified, according to their main action on the body, into the following groups :—

Choking.
Nose.
Tear.
Blister.

Arsine and hydrocyanic acid gas must also be considered.

Phosphorus, which is a solid, is used in incendiary bombs and in anti-tank grenades.

It should be realized that good training will be the most important factor in reducing gas casualties. Given good first-aid, nearly all gas casualties recover ; and the recovery from gassing is nearly always complete.

279. Tear gases.—The vapour of the tear gases causes mild irritation of the eyes, with much watering and with spasm of the lids, but it does no permanent harm. A drop of liquid tear gas in the eye, however, will immediately cause intense pain and spasm, damage to the cornea and congestion of the conjunctiva. Blindness has occasionally followed, and even in the milder cases full recovery may take several weeks.

Treatment.—Wearing the respirator, or moving to a gas-free area, brings rapid relief after exposure to vapour of tear gas, and other treatment is seldom required. Casualties should not be evacuated to the medical services. If, however, any of the liquid has entered the eye, immediate and thorough flushing out with water should be performed, and the patient should be seen by a medical officer as soon as possible.

280. Nose gases.—The results of exposure to these gases may not show for several minutes, the time of onset of symptoms varying from ½ to 5 minutes according to the amount of gas present. The effects produced are a burning and aching pain along the windpipe and in the throat ; also sneezing, headache, and pain in the gums. Salivation, nausea (*i.e.* a feeling of sickness) and vomiting are sometimes seen. Later, in more severe cases, there may be depression.

Treatment.—On removal to an atmosphere free from the gas, recovery is usually rapid without treatment. Men affected by nose gas should not be evacuated.

281. Choking gases (lung irritants).—These include chlorine, phosgene and chloropicrin. When they are inhaled they irritate the air-passages and the lungs.

The first effects are due to spasm in the breathing tubes, which closes the air inlet to part of the lungs. Consequently the patient cannot fill his lungs completely with air, and suffers from partial lack of oxygen. He can get enough oxygen to maintain his body at rest, but if he continues to exert himself he will need more. If he cannot obtain this he may collapse and may even die soon afterwards. As a rule the spasm passes off, and the man may feel quite fit until some time later, when further signs develop.

The later effects are due to the gas damaging the capillary blood-vessels in the walls of the air-cavities of the lungs. There is intense congestion, and the air-cavities fill with fluid which has oozed out of the injured blood-vessels. As a rule this happens gradually. The lungs, as they become water-logged, take in less and less air, and the patient suffers from increasing lack of oxygen. Any exertion at this stage may be rapidly fatal.

Owing to the leakage of fluid from the blood-vessels into the air-cavities of the lungs, the blood becomes concentrated and thick. In this state it is less easily pumped round the body, and an extra strain is thus thrown on the heart, which may gradually weaken and eventually fail.

IMMEDIATE SYMPTOMS after inhaling the gas are irritation of the eyes, cough, catching of the breath, difficulty in breathing, and sometimes vomiting. These effects may pass off and men may then feel well for as long as 12 hours.

LATER SYMPTOMS come on after this :—

(*a*) Casualties may collapse and die quickly. Death is due to lack of oxygen and is most likely in those who have gone on working after apparent recovery from the early effects.

(*b*) In *mild cases* the face is slightly flushed and the patient suffers from headache, pain in the chest (especially on taking a deep breath), and cough with frothy expectoration. He breathes quickly.

(*c*) *Severe cases.*—The patient suffers from great lack of oxygen but his heart is still beating strongly and his face is flushed or even plum-coloured. This is known as the " blue type." Veins may stand out

on the forehead, and the pulse is full. The breathing is rapid and difficult, and a severe cough brings up much frothy fluid from the lungs. These patients are very restless and need careful and considerate nursing.

(*d*) In the *most serious cases* the stage of heart failure has arrived. The patient, who may be delirious or semi-conscious, has a grey leaden pallor with purple lips. This is known as the "grey type." The pulse is weak and the breathing rapid and shallow. He may continue to cough up frothy fluid from the chest, and fluid may even flow from the mouth.

(*e*) In *fatal cases* death generally occurs in the first 24–48 hours, but occasionally it follows later from complications such as pneumonia.

FIRST-AID TREATMENT.—Stretcher-bearers can save life by correct first-aid. Rest and warmth are essential; make even a mild case a stretcher case. Give only hot sweet tea; no alcohol or smoking must be permitted. Artificial respiration should *never* be employed, even if the breathing is difficult (para. 200).

Evacuate as early as possible to the medical officer.

In case of doubt, when men have inhaled choking gas, they should be kept under observation, completely at rest, for 24 hours; if no symptoms have developed by then, the danger is past. If the tactical situation demands it, such men may of course have to go on fighting.

LATER TREATMENT.—The essentials are *rest, warmth and oxygen,* with *bleeding* in suitable cases. Absolute rest and warmth must be continued; bedpans and urine bottles must be used.

Oxygen should be given to the blue and grey types of case under the orders of the medical officer.

Bleeding.—In the blue cases, bleeding up to 20 ounces may do good. This will be carried out by the medical officer.

282. Blister gases.—Mustard gas and lewisite are the principal gases in this group. They are liquid at ordinary temperature and evaporate slowly, giving off invisible vapour.

Casualties may be caused either by contact with the liquid or by exposure to the vapour. The gases may be used in many types of missile or weapon, including shell and bomb, or may be sprayed from aircraft.

283. Effects of mustard gas.—On first contact a faint odour resembling garlic or onions is noticed; but the sense of smell is quickly dulled, and after a short time men may not

notice any smell, and so may fail to recognize the presence of dangerous vapour. The gas causes no immediate irritation, so it can be detected only by the smell. Lack of smell, however, does not mean that the gas is absent; for if the liquid is frozen, or nearly frozen, very little vapour is given off.

Mustard gas acts on the eyes, the respiratory system and the skin.

Eyes.—The effects of vapour on the eyes will not be felt until about 4–12 hours after exposure. They vary, according to severity, from mild inflammation, with redness and watering, to a distressing condition in which there is pain and swelling of the lids which closes the eyes.

This swelling of the lids may prevent a man seeing for several days. Inflammation of the conjunctiva may set in, and sometimes damage is done to the cornea. The mild cases recover in a fortnight or less, but the severe ones may remain in hospital as long as six months.

Vapour rarely causes permanent harm; but if a drop of liquid enters the eye the results are always serious. Little or no irritation is felt at first, but inside an hour the damage begins to show. The effects resemble those of vapour but are worse.

Respiratory system.—In mild cases, after inhalation of the vapour, the voice becomes husky and there may be pain behind the sternum, accompanied by a painful cough. In severe cases inflammation of the air-passages may develop, and infection with bacteria may give rise to pneumonia or abscess of the lungs. These have been the main cause of death in casualties due to mustard-gas vapour; but deaths are rare.

Skin.—On exposure to the vapour there is no immediate irritation; but, after a period which may vary from 2 to 48 hours, intense itching is felt. This is followed by redness, and later small blisters may appear, which often join together to form larger ones. In mild cases there may be no blisters.

The vapour is particularly liable to attack those parts of the skin which are normally moist, such as the scrotum, armpits, and groins. Burns in these situations are always painful.

When liquid mustard gas comes in contact with the skin it penetrates rapidly, but there is no pain or irritation at first. Later the condition develops in the same way as a bad vapour burn, except that redness and blisters are seen sooner.

As long as mustard-gas blisters remain unbroken they cause very little pain, and the blister skin protects them from dirt. When they are broken, the raw area left behind is painful and very liable to go septic. Stretcher-bearers should always try to prevent blisters from being broken.

284. Effects of lewisite.—The liquid in the pure state is colourless and gives off a vapour with hardly any smell. Crude lewisite, which may also be used, smells like geraniums. The vapour of both the crude and the pure forms is extremely irritating to the eyes and nose and immediately causes spasm of the eyelids and sneezing.

The irritation is so great that men will be forced to put on their respirators. Effects of vapour on the eyes and lungs, therefore, should be seen only in unprotected personnel. In these cases they will resemble those of mustard-gas vapour. The effects of liquid on the eyes and skin are more acute.

Eyes.—If a drop of liquid lewisite enters the eye there is at once severe pain and spasm. Unless proper treatment is given, the lids will swell rapidly and the eye will be permanently harmed.

Skin.—Liquid lewisite penetrates the skin almost immediately, causing a stinging sensation. Redness appears in the contaminated area in about half an hour, and the blisters which form are fully developed in a few hours.

Lewisite shock.—The arsenic which lewisite contains may be absorbed through the skin into the blood; it is then carried round the body where it may do serious damage to the liver, kidneys and other organs. As a result of the absorption of lewisite through the skin, a form of shock may develop in an hour or so. Men who have had their skin contaminated with many large drops or a splash of liquid lewisite, and have been unable to carry out personal decontamination, should be evacuated to the medical officer for further treatment against shock.

285. Prevention of blister-gas casualties.—Prevention is the responsibility of the man himself and his unit. The medical services are responsible only for those who become casualties, either from wounds or gas. Personal decontamination should be performed as soon as possible after exposure to gas, and consists in :—

(*a*) Removal of liquid blister gas from the skin with cotton waste.

(*b*) The rubbing of gas ointment into the exposed skin for half a minute. This should include the legs if trousers are not worn, for stockings afford no protection.

(*c*) The removal of contaminated clothing.

(*d*) The application of gas ointment to the skin which lay under contaminated clothing.

These steps are generally known by the initials C.O. E.C. D.O.

If gas ointment is not available, bleach cream (bleaching-powder mixed to a creamy consistence with water) may be

applied to the contaminated skin. This is irritating to the skin and must be washed off after a minute. As an alternative, thorough cleansing with soap and water may be employed. This does not destroy the blister gas, but removes it mechanically. Gas ointment and bleach cream must not be put on the skin if redness has developed, for they will make the condition worse; nor must they be allowed to enter the eyes.

If liquid mustard gas is in contact with the skin for more than a very few minutes, no treatment will neutralize the resultant damage. Even at this stage, however, efforts must be made to remove any liquid remaining on the skin or clothes which might cause further burning. The same applies to the vapour when it is in strong enough concentration and the time of exposure is sufficiently long. Men who arrive at a dressing station wearing contaminated clothing are going to be blistered, whatever is done for them; but it will still be necessary to remove this clothing, not only for their own sake but also for the sake of others. The vapour it gives off is very dangerous in an enclosed space such as a dressing station.

286. Treatment of blister-gas casualties.—The most urgent problem is the treatment of eyes contaminated with liquid blister gas. Any person thus contaminated should from the first be regarded as a casualty.

Eyes.—The immediate treatment of liquid blister gas in the eye is to flush out the eye with water, flooding it repeatedly for five minutes. If this treatment cannot be undertaken within five minutes of the liquid entering the eye, it had better not be done. If the eye is already inflamed, flooding is definitely wrong. Care is needed not to wash liquid into the eye from the lids, or into the other eye.

When symptoms develop after exposure to *vapour*, flushing out the eyes is unnecessary and useless.

When liquid lewisite enters the eye, or when the eye is affected by lewisite vapour, the poison must be neutralized as soon as possible with an anti-arsenical preparation, according to instructions.

Subsequent treatment for blister-gas contamination consists chiefly in keeping the lids clean and the pupils dilated by drugs. Drops of a special mild antiseptic are sometimes useful, but regular irrigation of the eye is seldom advisable. A shade is worn to protect the eye from light, which may at first distress the patient, and his fear of blindness must be removed by reassurance.

Skin.—Burns due to liquid blister gas are liable to go septic, and great care is necessary to avoid infection. The blister skin gives good protection against dirt; blisters, therefore,

should *not* be punctured by stretcher-bearers, but should be protected from damage with a dressing.

At the dressing station blisters may be punctured, after thorough cleansing of the surrounding skin, and a sterile dressing is applied. If the injury is due to liquid lewisite, anti-arsenical lotion or other preparations are used.

Other symptoms.—Nausea and vomiting, which are often troublesome in the early stages, may be relieved by drinking warm water containing 2 per cent. bicarbonate of soda. Hoarseness and cough are relieved by inhalation of steam from hot water to which has been added friar's balsam (tinct. benzoin. co.) half a teaspoonful to the pint.

It should be impressed on all casualties from blister gas that complete recovery is the rule.

287. Hydrocyanic acid (prussic acid) gas.—When the quantity of this gas in the air is small, it may be borne for a considerable time without harm; but once a poisonous concentration is reached its action is rapid. Symptoms follow each other in rapid succession—giddiness, mental confusion, headache, indistinct sight, pain in the chest, laboured breathing, convulsions, and finally failure of the respiration and of the heart. With large doses death is almost immediate.

Treatment.—Instant action is necessary. The patient must at once be brought into fresh air, and, if the breathing is failing, artificial respiration should be begun without delay. Administration of oxygen, or (better still) oxygen containing 7 per cent. carbon dioxide, is of great value. During treatment the patient must be kept warm.

288. Arsine.—This gas is invisible, has no smell and causes no irritation when breathed. It does not injure the lungs, but is absorbed into the blood where it destroys the red corpuscles. In slight cases the main symptoms are headache, giddiness, fatigue, and pallor of the face, followed by mild jaundice. In more serious cases these symptoms are worse and there may be shivering, vomiting and diarrhœa, sometimes with blood in the motions. The urine, which is scanty, is bloodstained or almost black. Jaundice is intense.

First-aid treatment.—Casualties must be kept warm, given plenty of fluids and evacuated as stretcher cases.

289. Phosphorus and carbon monoxide.—Phosphorus is a filling for incendiary bombs or shells. It catches fire when exposed to air, and may burn the skin. The treatment of phosphorus burns is described in para. 183.

Carbon monoxide, though a poisonous gas, is not used in chemical warfare. An account of its effects and their treatment was given in para. 205.

CHAPTER 43

CLASSIFICATION AND DISPOSAL OF GAS CASUALTIES

290. The efficient sorting and disposal of casualties, when chemical weapons are employed, will depend both on the type of casualty and the way in which it has been produced. In the war of 1914–18, particularly in the early periods, new chemical compounds were continually being used against us, and the enemy could rely largely on surprise. Chlorine and phosgene, and later mustard gas, caused many casualties because the means of defence at our disposal at that time were very imperfect. Conditions have now altered, and we have in the present respirator a means of defence against all these compounds. But the respirator will not, of course, protect the limbs and trunk from contamination by blister gases, and problems arise in the sorting and disposal of casualties caused in this way.

291. Contaminated personnel.—These may be divided into three classes :—

I. Contaminated with gas but not gas casualties.
II. Contaminated with gas and already gas casualties.
III. Wounded who are also contaminated with gas.

The R.A.M.C. is concerned only with casualties, and is not responsible for personnel in Class I. An unwounded man contaminated with blister gas is not a casualty—and should not be sent to the medical services—unless (*a*) he is unable to see ; or (*b*) he has lung symptoms ; or (*c*) he has blisters which prevent him from fighting ; or (*d*) he shows systemic effects, *e.g.* from lewisite.

Blister-gas casualties (Class II) and contaminated wounded (Class III) require decontamination. They can then be treated with uncontaminated casualties.

292. Decontamination of casualties.—Decontamination may be done in the field or at the dressing station.

In the field.—Walking wounded should receive first-aid, followed by immediate personal decontamination if this has not been carried out already.

When wounds are more severe (lying cases) any extensive decontamination, with removal of clothes, is undesirable

because it will increase shock and delay the casualty's reception at the dressing station. All that should be done, therefore, is to render first-aid and remove obvious contamination of the skin. "Better the blistered living than the decontaminated dead."

At the dressing station.—Contaminated casualties must be decontaminated if this has not already been done; but here again the condition of the patient must be considered before full decontamination is performed. After being cleansed, casualties can be treated with the "clean" cases.

The dressing station should be divided into "clean" and "dirty" areas, and the following lay-out is a guide to what is required :—

	Dirty			Clean	
Entrance "dirty" cases →	A →	B →	C →	D →	E →
			↑ Entrance "clean" cases		

The accommodation may vary from areas marked on the ground to specially erected buildings, and the dirty area may be a short distance away from the clean.

In Area A all heavily contaminated clothing and equipment should be removed, and in Area B the skin should be treated with gas ointment, bleach cream, or soap and water. Areas C, D and E are the remainder of the dressing station, where reception and treatment are undertaken and where patients await evacuation.

293. Classification for evacuation.—For the purpose of evacuation, chemical warfare casualties in general may be divided into three groups :—

(*a*) *Slight cases.*—In the first place, the moral effect of chemical weapons is very great. In a gas bombardment many men, worried and shaken as they may be by the stress of war, will believe they have been "gassed," and in that belief will report at a regimental aid-post or field ambulance when in reality they have only smelt the fumes of ordinary high explosives, or gas in so low a concentration that it will do them no harm. Very careful examination and consideration of the evidence obtainable is therefore necessary before men are labelled as gas casualties. Casualties from the tear and nose gases, except liquid in the eye, are usually slight, and the majority will be fit to return to duty at once.

(b) *Early acute cases.*—In cases of poisoning by choking gases, active movement should be reduced to a minimum. All such patients must therefore be treated from the first as stretcher cases, and should be evacuated lying down until convalescence is well established. The patient should, if circumstances permit, be detained for two days by the first medical unit capable of giving him adequate treatment.

(c) *Late acute cases.*—As the appearance of symptoms in these cases is delayed, there is time to arrange for their disposal and treatment. In mustard-gas poisoning the lung trouble (bronchopneumonia) seldom develops before the third day after exposure; so a patient with early injuries to the skin or eyes may be allowed to walk from the fighting area and may afterwards be sent on as a sitting case.

294. General.—Success in the use of chemical weapons largely hangs on surprise—*i.e.* the possible use by the enemy of some substance against which no defence is ready. The possible use of mixtures of gas should also be remembered.

It is of great importance that all ranks should bring to notice any information likely to lead to the identification of new substances, *e.g.* unusual signs and symptoms appearing among casualties. The notes on the Field Medical Card (A.F. W 3118) should be as full as possible.

SECTION VI.—NURSING

CHAPTER 44

THREE ESSENTIALS

295. Disease may arise from lack of proper food ; or from absorbing poisonous substances ; or from unhealthy living ; or from the irregular behaviour of cells or tissues of the body. But the commonest immediate cause of illness, as seen in hospital, is *infection*—*i.e.* an attack by the very small animal and vegetable organisms and viruses generally known as germs or microbes.

Some of these germs enter the body through the skin ; for example, the organism causing malaria goes in through the hole made by the mosquito when it sucks blood. Others, like the diphtheria bacilli, settle in the nose and throat ; or, like the bacteria producing pneumonia and tuberculosis, find their way to the lungs. Others again, including the germs of typhoid fever, food-poisoning, dysentery and cholera, arrive in the stomach or bowel in food or drink.

Having gained entrance, the germs may increase enormously in numbers and often form poisonous substances called toxins, which produce local and general effects. Examples of local effects are the sloughing and ulceration of the bowels in typhoid fever and dysentery, the profuse diarrhœa of cholera, the inflammation of the lungs in pneumonia, and the formation of a membrane in the throat in diphtheria ; examples of general effects are fever, sweating, wasting, weakness, prostration and delirium.

When germs invade the body and form their poisons, the body responds by bringing its defensive forces into action. Most of the organs of the body take part in its defence, either by destroying the invading germs or by neutralizing the effects of their toxins. In certain diseases we can help the body by giving drugs that have a direct action on the invader ; for instance, quinine in malaria. But in every case we also depend on Nature's processes of cure, which we can best help by efficient nursing.

296. Rest.—The first essential in nursing is to place the patient at rest. This prevents unnecessary expenditure of energy with consequent weakening of the powers of defence.

The patient's digestion may be enfeebled and his diet may

have to be regulated accordingly ; otherwise the presence of undigested food in the stomach and intestines will cause discomfort or even danger.

When but little nourishment is being received by way of the mouth, the body, in order to keep going, has to draw on its own resources. The fat, the liver, and the muscles are storehouses of food material, which is used in this emergency to supply the heart, blood, and blood-forming organs with nourishment ; the food stores of the fat and muscles must be conserved by protecting the patient from cold and keeping his muscles at rest.

The strain of illness falls mostly on the heart. In fever the heart beats more rapidly and expends more energy, while at the same time it is weakened by the toxins formed. Hence the importance of easing its work by keeping the patient in bed. Neglect of this precaution may have serious consequences. In dysentery, for instance, it is not uncommon for patients to faint if they are allowed to go to a lavatory instead of using a bedpan, and in the course of a severe illness even sudden sitting-up in bed may cause fatal heart failure.

The heart and the nervous system are closely connected, and anything that disturbs the nervous system disturbs the heart. Therefore the patient must be kept free from excitement and worry and, if possible, from pain, and he must be given every encouragement to sleep.

297. Observation.—The second essential is trained and careful observation of the sick. When a patient reports sick, he complains of certain things, and these are called his "symptoms." The medical officer then looks for the "signs" of disease. If the nursing orderly takes an intelligent interest in the symptoms, he can give valuable help in the diagnosis. For instance, if a patient complains of a cough and of spitting up phlegm, the orderly should at once give him a sputum mug for collection of the sputum ; its examination may disclose the nature of the disease.

The first thing that the medical officer asks for when he visits a patient is the nurse's report. He himself has to rely, so far as his own observations go, on a short visit to the ward, which may be at a time when the patient is not at his worst, for it often happens that the patient's condition varies from hour to hour. The nursing orderly, therefore, should not only cultivate his powers of observation ; he should also learn how to place his observations on paper, and he should practise writing out reports, which must be short and clear.

Successful nursing, however, depends also on the ability of the nurse to help the patient and to relieve his suffering. This is put to the test in dealing with a helpless patient. It is

not enough to place him at rest in bed, wash him, feed him, make his bed and give him the bedpan. A helpless patient tends to lie inert on his back, and this position is apt to produce congestion (or waterlogging) of the lungs, sometimes sufficient to cause death. The position of the patient must be altered from time to time, so that he lies on one side or the other, or with the shoulders raised.

Another condition that threatens the lungs is a neglected dirty mouth. Accumulation in the mouth of dry mucus and saliva mixed with decomposing particles of food—which forms a brown film called *sordes*—encourages the multiplication of germs, producing infection. This infection may extend down the respiratory passages to the lungs and cause septic pneumonia ; or along the salivary ducts to inflame the parotid glands. It is most important that the patient, his surroundings, and the equipment used in nursing him, should all be scrupulously clean.

Care must also be taken to prevent bedsores, which are not only a source of discomfort and pain, but also, when they become septic, a danger to life. Apart from the prevention of bedsores, much can be done to ease discomfort by attention to the skin. The skin, together with the kidneys, performs an important function in getting rid of waste-products which would be harmful if allowed to accumulate in the blood.

In some diseases, such as acute rheumatism, undulant fever, and malaria, sweating is a prominent symptom, and the skin is apt to become sodden. When this happens, resistance to germs is lowered, and prickly heat and boils may readily develop. Also, if a patient is left in damp clothes, he may get a chill, perhaps leading to rheumatism or pneumonia.

298. Disinfection.—The third essential is that a nurse should understand the principles of disinfection. He must keep in mind the fact that a sick man may be a source of infection, not only directly to his attendants and those who come in contact with him, but also indirectly to others.

299. Duties of the orderly.—The duties of a nursing orderly are many and varied. He must attend to the general comfort of his patients in the ward and he should always be within call in case his help is needed. He is concerned with :—

The hygiene and management of the ward.
The hygiene and nursing of the patient.
The feeding of the patient.
Observation of the patient and rendering of reports.
The administration of medicines and treatment.
The care of equipment.

For time-table of war duties, see Standing Orders R.A.M.C., 1937, para. 283.

The essential qualifications of a good nurse are cheerfulness, quickness, gentleness, tact, firmness, reliability, good powers of observation, cleanliness, thoughtfulness, patience, and loyalty.

CHAPTER 45

HYGIENE AND MANAGEMENT OF THE WARD

300. Ventilation of wards.—Ventilation is the supply of fresh air and the removal of impure air. To keep a ward wholesome, it is necessary not only to regulate its temperature but also to provide for the entry of fresh air at all times, day and night.

Composition of air.—Air consists almost entirely of two gases, oxygen and nitrogen. A little more than one-fifth is oxygen, a little less than four-fifths is nitrogen. There is also a minute trace of carbon dioxide, and a small quantity of water vapour.

In the wards of a hospital the air soon becomes loaded with impurities.

By the act of respiration, every person in a ward is constantly engaged in removing oxygen from the air and adding carbon dioxide and water vapour to it. The atmosphere is also made unwholesome by emanations from the patients' bodies, linen and excreta; by any foul wounds or soiled dressings; and sometimes by the burning of gas, each jet of which consumes far more oxygen than a man.

To keep the air pleasant, it is important to attend to the personal cleanliness of patients and to remove all excreta or soiled dressings from the ward without delay. Frequent and thorough changing of the air is also necessary in order to counteract the continuous fouling of the atmosphere. A warm moist stagnant atmosphere interferes with the functions of the skin and lowers the patient's powers of resistance. It also favours the spread of droplet infections, by germs passing through the air from one patient to another.

Principles of ward ventilation.—These are :—

(*a*) The air in the ward must be kept, as nearly as possible, as pure as that outside, without chilling the patients.

(*b*) The temperature of the ward is best maintained at or near 60° F.

(*c*) Ventilation must be systematic, and sufficiently thorough to renew the air in a ward completely at least three times in an hour.

In acting on these principles there are two simple but important facts to be remembered :—

(*a*) Air expands when it is heated ; therefore, as the air in a room grows warmer, some of it escapes by the nearest outlet.

(*b*) Because of its expansion, hot air is lighter than cold air ; therefore hot air rises, and cold air, being heavier, falls.

Outlets.—Foul air escapes from the room by the chimney, the windows and the ventilating outlets. Being lighter than pure air, it is found in the upper part of the room Ventilating outlets are therefore usually placed in the ceiling. For the same reason the windows should be left open at the *top* to enable the warm impure air to escape.

A fireplace is an important aid to ventilation ; for, especially when a fire is burning, a current of air is always flowing out of the room by the chimney.

Inlets.—Fresh air enters a room by ventilating inlets and by the windows. In hospitals the ventilating inlets are so arranged that the amount of air coming in can be regulated and generally diffused over the room, thus preventing draughts. In modern hospitals the air, on entering these ventilators, is warmed by coming into contact with hot-water pipes. In the absence of hot pipes the cold air should be introduced above the level of patients' heads, so that it reaches them after mixing with the warm air of the ward.

Windows have already been considered as outlets for foul air ; they also act as inlets for a large quantity of pure air, and this is another reason for keeping them open. Fresh air also enters a ward every time the door is opened, and underneath the door even when it is shut ; but, if this air comes from inside the building, the door should not be regarded as a suitable means of ventilation.

Patients often complain of cold when the windows are kept open, and the orderly must use consideration and tact as well as firmness. An extra blanket or a hot-water bottle will generally keep a patient warm.

Duty of attendants.—Ventilation requires unremitting care from attendants on the sick. Neglect of this duty favours the development or spread of disease, retards the healing of wounds and generally lowers the health of the patients. To test the air of a ward, the orderly should from time to time go into the open air ; on re-entering he will at once be able to detect impurity in the atmosphere.

301. Kitchens.—Keep sinks scrupulously clean at all times. Grease in the drain can be removed with washing soda dissolved in hot water. Scrub woodwork and polish brasses daily, and clean paintwork and windows once a week.

Bread-bins should be emptied of all old bread (which should be taken to the cookhouse for use), washed daily, and thoroughly dried before use. Milk receptacles must be scalded daily with boiling water. Swill-tubs should be emptied and well washed out twice a day.

302. Annexes.—Waste pipes and sinks in the annexes should be properly cleaned and flushed daily. Baths should be thoroughly washed daily and rinsed round after use. All brasses should be polished. All woodwork should be scrubbed daily and the paintwork and windows cleaned weekly.

Do not let the inside of pans get stained. Keep all vessels in use thoroughly clean ; bedpans and urinals must be cleaned and dried immediately after use.

Never leave soiled or infected linen or soiled dressings in uncovered receptacles. Buckets for soiled dressings should be emptied and cleaned at least twice a day, after the morning and evening dressings are finished.

303. Floors of wards.—Ward floors should be swept every morning and evening after bed-making, and after meals if required. Beds and lockers should be pulled out from the walls before the morning sweep.

In sweeping hospital floors it is important to raise as little dust as possible, since dust contains germs which contaminate the air. Damp tea-leaves, sprinkled over the floor before sweeping, will prevent the dust from rising. Sweeping should be finished at least one hour before ward dressings are started.

Spindle oil is now used on wooden floors or linoleum to stop dust rising. The dust, instead of blowing about, tends to stick to the floor ; and though the oil does not kill the germs in the dust, it prevents their distribution.

When floors are polished they should first be swept. Apply the polish on house flannel to a section of the floor, rub it well in, dry it, and polish with a heavy weighted long-handled brush ; do the corners by hand. Polished floors should be either well scrubbed with hot water and soft soap, or washed over with white spirit, at least once in six months.

304. Dusting.—Wards should be dusted twice a day, first with a damp duster, then with a dry one for polishing. Special attention should be paid to electric-light shades and similar fixtures. Dusters should be washed daily.

305. Stoves.—The cleaning of stoves should be completed, and ashes removed, before the morning sweeping of the ward ;

care must be taken not to soil other things. In cleaning a stove a good plan is to hold a thin strip of wood with one hand against the surrounding wall while the brush is used with the other hand. The blacklead should be made into a thin paste and applied with a small round brush to every part that is to be blacked. When the blacklead is dry, the polishing brush should be used briskly until every part of the ironwork shines. The ends of the fire-irons are cleaned in the same way as the stove, and the bright parts are rubbed with bathbrick or burnished.

The fire should be allowed to get low in order that the stove may be cleaned when it is not too hot.

306. Walls, windows and paint.—Walls should be swept once a week with a high dusting brush covered with a soft cloth, and washed down every three months.

The woodwork of windows is cleaned by washing with warm water and soap; the glass by sponging with water, and polishing with a clean dry duster. Wipe over the glass daily with a duster or newspaper to keep it in good order. Cloths used should be free from nap or fluff. Blinds must be kept free from dust.

The paint-work of a ward should be scrubbed from time to time with hot water and soap. Soda must not be used, for it soon destroys the paint or enamel.

307. Woodwork and utensils.—Bedside tables, chairs and patients' bed-head boards should be well scrubbed once a week, and diet trays daily; other articles of white wood should be scrubbed once a week with hot water and soap.

Brasses are polished with a patent polish or a paste made of finely powdered bathbrick and water; if very dirty, they should first be washed in hot water.

Vessels of tin or white metal are best cleaned by washing with hot water to remove the grease and then polishing with whitening.

When washing knives, do not put the handles into the hot water.

Wash tumblers and all glass articles separately; if necessary place them first in warm water with soda and then in cold water.

Crockery must be carefully washed. Pay special attention to the spouts of feeding cups, which should be cleaned with a small brush.

308. Ward neatness.—A ward is more efficient if it is neat. Arrange the contents of each locker in the same way; also hats and boots and shoes. Beds should be in line, made

in a uniform manner with the even end of the pillow-case facing the ward entrance. After dressing the beds and putting the castors in line, take a final look round the ward to make sure that everything is tidy.

309. Ward discipline.—Under the direction of the medical officer and the sister, the orderly is responsible for the discipline of the patients. He must maintain order at all times and report any irregularity to the sister in charge. He must see that patients get up and return to bed as ordered by the medical officer, and that all patients marked " up " are in bed at the proper hour at night.

CHAPTER 46

HYGIENE AND NURSING OF THE PATIENT

310. Baths and washing.—All patients marked " up ", and those able to go to the bathroom, should have a bath twice a week. A bath list should be kept for this purpose. The face, neck, chest, back, arms and hands should be washed twice a day.

All patients unable to go to the bathroom should have a blanket bath on admission, unless otherwise ordered by the medical officer or sister, and should be blanket-bathed at least twice a week. Patients who are seriously ill, and those who sweat much, need a daily blanket bath. If a blanket bath is given in the evening, the face, neck, chest, back, arms and hands should be thoroughly washed in the morning ; and *vice versa*.

311. The blanket bath.—In giving a blanket bath :—

Have everything ready before starting.
Avoid draughts and unnecessary exposure.
Use plenty of hot water and soap and dry towels.
Wash briskly and quickly (but not roughly) to avoid tiring the patient. Afterwards see that every part of the body is clean and dry.
Note and report any rash, swellings, scars, scratches or sores.

In taking off the shirt or pyjamas, remove the sleeve of the jacket, or leg of the trousers, from the injured side last, and replace it first. For a helpless patient use a gown split up the back.

Do not omit the brushing of the teeth, the cleaning and cutting of the nails, and the washing of the head if necessary.

Articles required.—These are shown in Fig. 72. Screens will also be needed.

Method.—Remove the top bedclothes, and cover the patient with one warm blanket or bath sheet. Roll under him the waterproof sheeting, covered with the other warm blanket or bath sheet. Remove his shirt or pyjamas and place them to warm.

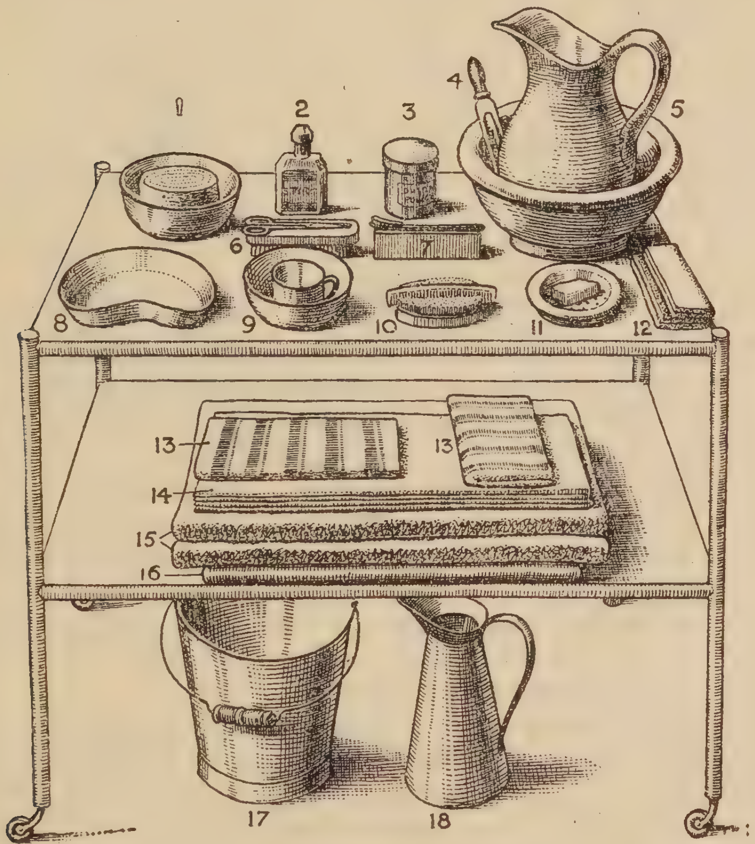


FIG. 72.—BLANKET BATH.

1. Tow	10. Hairbrush and comb
2. Spirit	11. Soap and dish
3. Dusting powder	12. Two flannels
4. Bath thermometer	13. Pyjamas
5. Jug of warm water and basin	14. Bath towel
6. Nailbrush and scissors	15. Two blankets (worn)
7. Toothbrush and paste	16. Mackintosh sheet
8. Kidney dish	17. Pail
9. Mouth-wash and receiver	18. Jug

Wash the parts in the following order and dry thoroughly :—face, neck and ears, arms, chest ; abdomen, legs, between the legs ; lastly the back. Always wash between the legs under the blanket. Change the water before turning the patient to wash his back.

Keep the patient well covered with the blanket, exposing only the part that is being washed. When the back is washed and dried, apply methylated spirit, and then dusting powder, to the sacrum, hips and shoulders, and if necessary to the elbows, knees, heels and ankles, to prevent bedsores.

If the head is to be washed and the patient is unable to move freely, cover the chest and shoulders with a blanket and remove the pillows. Turn under the upper part of the mattress exposing part of the bedstead. Spread over this a mackintosh sheet, arranged to fasten in front of the patient so that it protects the blanket and the floor. Then place the basin containing fresh hot water on the mackintosh and wash the head, giving the hair a good rinse. After drying thoroughly, replace the shirt, brush and comb the hair, clean (and if necessary cut) the nails, and clean the teeth.

Then roll the patient over and remove the waterproof sheeting and blanket, making the under part of the bed. Shake up and arrange the pillows. Replace the top sheet and remove the upper washing blanket. Remake the top of the bed and put in a hot bottle if necessary.

312. Cleansing of the mouth, teeth and nose.—A patient who is not seriously ill should clean his teeth at least twice a day, preferably first thing in the morning and last thing at night.

Dentures should be taken out and cleaned with a toothbrush and mouth-wash twice a day. A patient who is seriously ill should not be allowed to wear them.

In the case of helpless patients the teeth should be cleaned, when possible, with ordinary tooth-paste or tooth-powder and a toothbrush. When the mouth is very dirty, it may be difficult to remove the sordes ; a solution of bicarbonate of soda (baking soda) will usually dissolve it ; a little hydrogen peroxide in the water is also useful.

The mouth can be swabbed out, after cleaning, with a preparation of glycerin (or liquid paraffin) and borax, with a few drops of lemon juice added. The glycerin or paraffin lubricates the mouth, and the lemon juice increases the flow of saliva. It is important that the mouth should be cleaned gently to avoid damage to the mucous membrane which lines it. The requirements are shown in Fig. 73.

Method.—Remove any dentures. Make a mop with a small piece of cotton-wool wound round a pair of forceps or a small

stick ; dip it in the mouth-wash and swab the gums, teeth and tongue. The patient, if able, should rinse out his mouth thoroughly with the mouth-wash.

Ulceration of the mouth or gums.—Men with ulceration of the mouth or gums should be seen by a dental officer at the earliest opportunity. Such affections may be highly contagious. All articles of crockery, knives, forks and spoons used by the patient should be specially marked for the use of that patient only, and they should be sterilized by boiling each time they have been used.

The nose must be kept clear of any discharge or dried crusts.

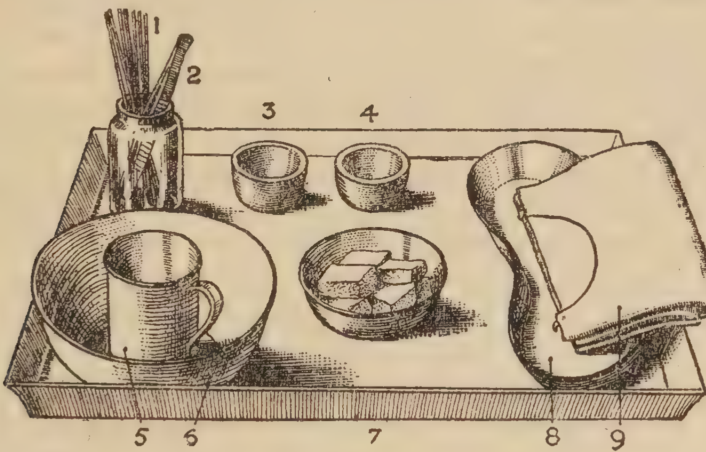


FIG. 73.—MOUTH TRAY.

1. Orange sticks
2. Forceps
3. Glycerin and borax
4. Bicarbonate of soda
5. Mouth-wash.
6. Receiver
7. Wet swabs
8. Kidney dish
9. Jaconet sheet

BEDS AND BEDCLOTHES

313. Stripping and making beds.—Beds of up-patients should be thoroughly aired and the mattresses turned every day. A uniform method saves time both in stripping and remaking the bed. Bedclothes must not be allowed to trail on the floor.

To strip the bed, untuck all the bedclothes ; fold each blanket and sheet into three, and place them over a chair at the foot of the bed.

To make the bed, first lay a single blanket over the mattress ; over this blanket lay a sheet, leaving enough sheet at the top to roll the bolster in. Then firmly and tightly tuck in the sheet at the sides and foot, roll the bolster in the top of it, and place the pillow on top of the bolster. Spread the top sheet, blankets and counterpane one at a time, tuck them in round the sides and foot of the mattress, and fold them neatly

down at the head. A draw-sheet is used for all patients confined to bed; it is usually only half as wide as an ordinary sheet. When a waterproof sheet is used, the draw-sheet should be folded so as to cover the waterproof completely.

Waterproof sheets must be kept clean, smooth, and free from wrinkles. For patients with incontinence, who pass urine or fæces involuntarily, they should extend from the shoulders to the knees.

The beds of all patients confined to bed should be made twice a day, once in the early morning and again in the evening (after 5 p.m.). The evening washing and bed-making should be as late as possible, so that the patients may settle down to sleep soon afterwards.

When turning the mattress, help the patient on to a chair or lift him on to another bed or couch, unless this is contrary to the medical officer's orders.

314. Changing of sheets.—The method used depends on whether the patient can turn on his side.

For a patient able to turn (Fig. 74) :—

(*a*) Collect all clean linen required, and a pail for soiled linen. Untuck the bedclothes all round and remove the upper bedclothes except for one blanket. Remove all pillows except one (unless the patient is unable to lie flat) and pull up the mattress if necessary. Roll the patient gently towards you. Go round to the other side of the bed.

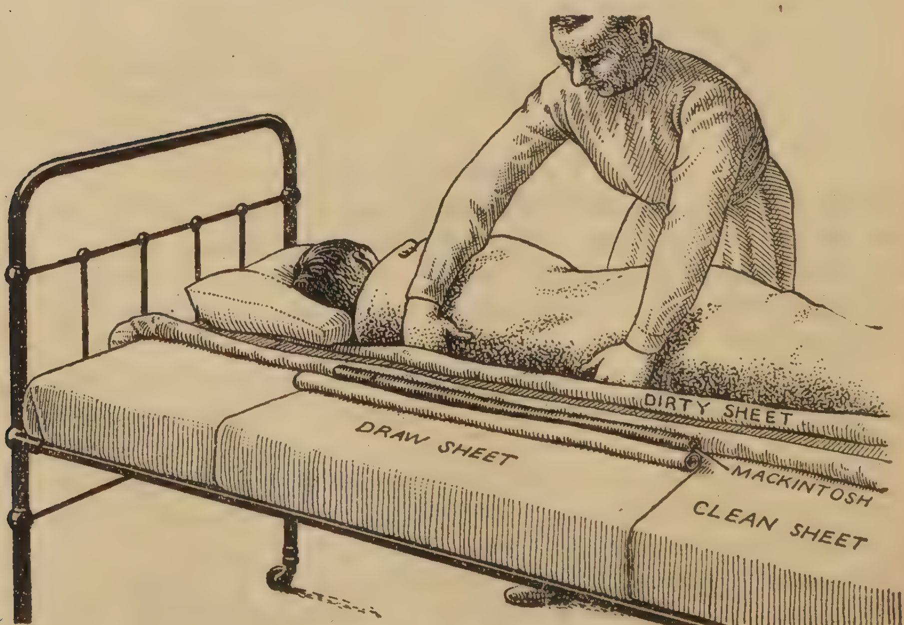


FIG. 74.—CHANGING THE SHEETS OF A PATIENT WHO CAN BE ROLLED ON HIS SIDE.

(*b*) Roll the clean sheet lengthways to half its width; take the lower sheet, the draw-sheet and the waterproof sheeting, if in use, and roll them up lengthways, along one side only, towards the patient's back.

(*c*) Place the clean sheet along the bed with its rolled edge against the rolled edge of the soiled sheet, and tuck in the loose side firmly, beginning at the foot end.

(*d*) Roll the patient gently towards you; go round to the other side of the bed, remove the soiled sheet, and pull through the clean one. Smooth and stretch it well to remove all wrinkles, and tuck in firmly.

If a draw-sheet, or waterproof sheeting, or both, are being used, they can be changed in a similar manner in their right order, and rolled through with the bottom sheet, thus making only one move for the patient.

For a patient unable to turn.—The sheet may be put on either from the top or from the bottom of the bed, preferably the bottom. If the draw-sheet is not to be changed, the ends should be turned back over the patient. To put on a sheet from the top of the bed proceed as follows:—

Untuck the soiled sheet and roll it crossways. Roll the clean sheet crossways to within a pillow's length of the top.

Cover the patient with one sheet or blanket and remove the rest of the top bedclothes.

Get someone to hold the patient's head and shoulders, or to support him forward, and remove the pillows and bed-rest. Roll the soiled sheet under the patient's head and shoulders as far as possible, tuck in the clean sheet across the top, and unroll it to follow the soiled one. With the help of an assistant on the opposite side of the bed, raise (with one hand each) first the shoulders, then the back and buttocks, and lastly the legs in turn, rolling down the soiled sheet and unrolling the clean one after it with the free hands. When the soiled sheet is out, tighten the clean one and free it from wrinkles by pulling it from each side, and then tuck it in. Replace the pillows or bed-rest, and finish making the bed.

Sheets and patients' clothes are changed at fixed intervals or as occasion demands—for instance, when they are soiled or after profuse sweating. The orderly must see that small articles such as handkerchiefs are always at hand, and so placed that the patient can reach them without effort.

315. Draw-sheets.—A draw-sheet is used for patients confined to bed. It is a sheet folded lengthways and placed across the bed above the lower sheet and under the patient's body. It should be drawn through fairly often, as it increases the comfort of the patient by leaving him a cooler surface to lie on. This must also be done

After meals to remove crumbs.
After washing or rubbing the back.
Whenever the sheet is soiled with discharges, or damp from perspiration.

To change a draw-sheet.—A draw-sheet can be changed either with the lower sheet, as described above, or alone. To change the draw-sheet alone, roll it up close to the patient, and pull the undersheet and mackintosh taut. Then tuck the greater part of the clean draw-sheet under the mattress, leaving just enough to tuck in comfortably on the other side of the bed. Go to that side, and, while the patient raises his back, if he is able, remove the soiled draw-sheet and pull through the clean one and tuck it in. A second orderly helps to raise the patient's back if he cannot do it himself.

316. Special beds.—Beds are arranged differently for different purposes.

Accident bed.—To prepare a bed for an accident or stretcher case, roll back the upper bedclothes as for an operation (Fig. 96, page 270) warming it with one or two hot bottles. Cover the under bedclothes with a blanket, on which the patient can lie until he is undressed or bathed.

Blanket beds are used, especially in rheumatism and kidney disease, to encourage sweating and prevent chill. The under bedclothes are made up in the usual way but with a blanket over the bottom sheet. A narrow draw-sheet (and mackintosh if necessary) is then put across the lower blanket. The patient is covered with a second blanket and the upper part of the bed is completed as usual.

Fracture beds are used for cases of fracture of the spine, pelvis or lower limb, where it is necessary to have the mattress firm and level. Before making up the bed, 4 to 6 fracture boards are placed under the mattresses with their ends resting on the framework of the bed at either side. An air-bed may be required ; also a bed cradle, sandbags and blocks.

"Divided" or amputation beds may be needed either (*a*) when the leg is slung on a Balkan beam or other apparatus, or (*b*) when a stump has to be left uncovered in case of bleeding.

The under bedclothes are made up as usual, and the patient is covered with one blanket, arranging the lower half to cover

the sound leg. The rest of the bed is then made in two sections, as follows :—

Fold the upper sheet in half : lay it across the upper half of the bed, leaving enough to turn back over the blankets. Fold a blanket similarly and place it over the sheet. Then turn the extra sheet back over the blankets and tuck in the bedclothes at the sides.

Make the lower half of the bed by folding a blanket and counterpane to the required size : place them, in turn, across the bed, over the sound leg and under the splint, and tuck them in at the foot and sides of the bed.

A good overlap should be left between the upper and lower sections to prevent draught and keep the patient warm.

In amputation cases the stump will be supported on a small pillow with a mackintosh cover, and a tourniquet will be attached to the bed.

Position of Patient

317. Position in bed.—A helpless patient cannot move without assistance. In some cases his position has to be changed from time to time : in others he remains in one position, such as sitting up or lying flat, as the medical officer may order. Patients confined to bed are usually placed in one of the following positions (Fig. 75) :—

(*a*) *Recumbent*, or flat in bed with one head-pillow. The knees are sometimes flexed over a pillow for greater comfort. This position is used in many forms of acute illness—in most of the fevers, in dysentery, in cases of shock, and in some injuries.

(*b*) *Semi-recumbent*, or on the back with two or more head-pillows, and a knee-pillow if required. Many patients, both medical and surgical, are nursed in this position.

(*c*) *Upright*, or sitting posture, supported by an upright bed-rest padded with pillows, or preferably by many pillows without a bed-rest ; the lower pillows, if placed at an angle, make supports for the arms. In this position it is advisable to use an air-cushion or water-pillow to prevent bedsores, and a pillow is needed under the legs. A pair of short blocks placed under the feet of the lower end of the bed help to prevent the patient from slipping down. This position is the best for patients with bronchitis and some other lung troubles ; or those with heart disease and much dropsy.

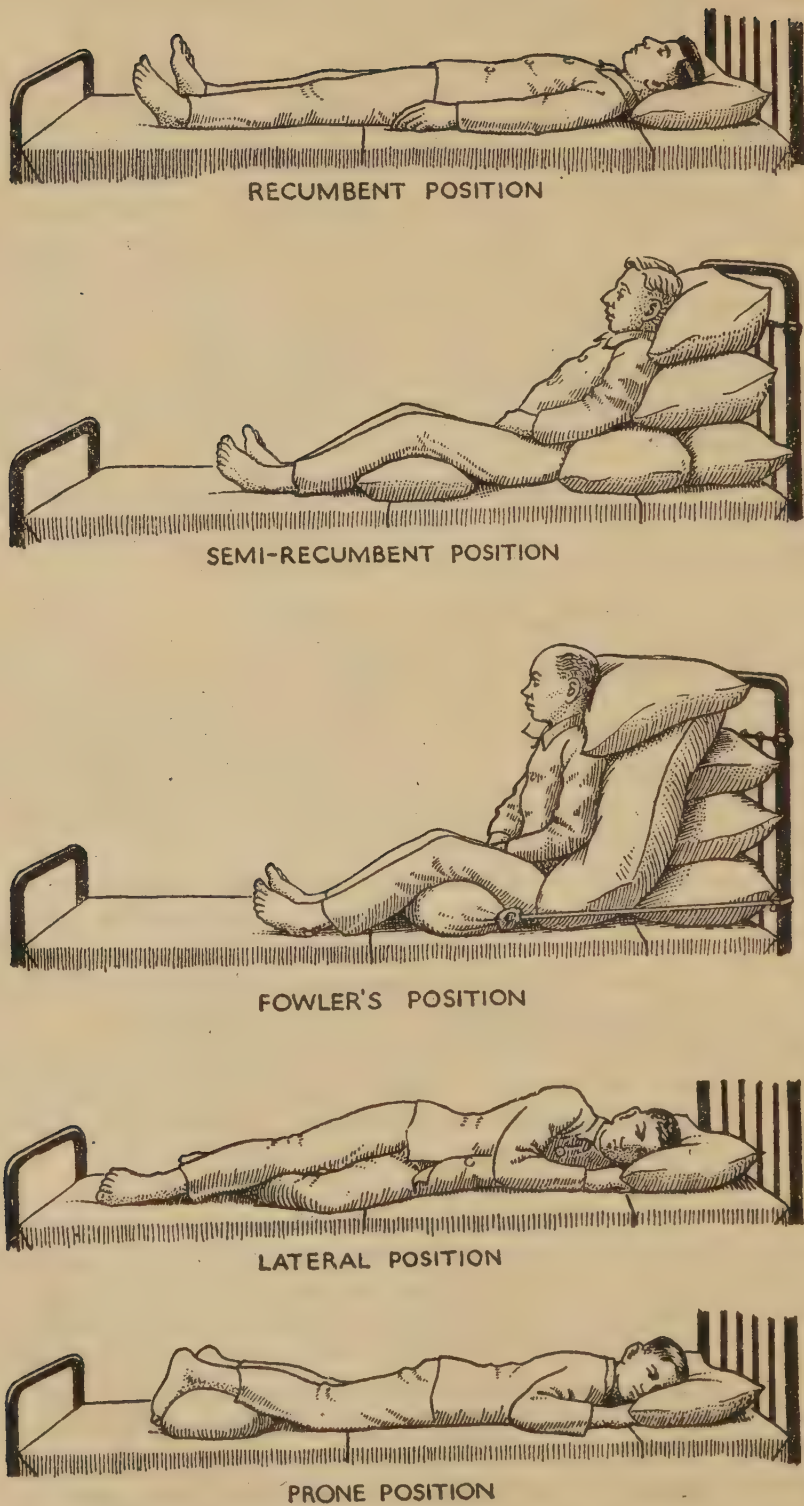


Fig. 75.—Positions for Patient.

(*d*) *Fowler's position*, or propped up as in the upright position, with knees flexed over a firm pillow or bolster. The bolster is tied to the bed-head or sides of the bed to prevent slipping. This position is indicated after most abdominal operations. A special bed is now available by means of which the Fowler position can be easily arranged and varied at will. When a bolster is used a mackintosh should first be wrapped round it and the whole well rolled in a draw-sheet

Fig. 76 shows Fowler's position as it should *not* be.

FIG. 76.—A WRONG INTERPRETATION OF FOWLER'S POSITION.

(*e*) *Lateral*, or on one side with one head-pillow, and one or two pillows to act as a prop for the back.

(*f*) *Prone* or lying on the front of the body, with a pillow under the feet to prevent pressure on the toes. A small pillow is required for the head and another under the chest is sometimes useful. This position may be used in cases of injury to the buttock and sometimes for unconscious patients.

MOVING OF PATIENTS

318. Moving from stretcher to bed.—Helpless patients very often have to be moved from a stretcher to a bed or operating-table, or from one bed to another.

Prepare the bed, rolling down the top bedclothes : and, if necessary, spread the waterproof sheeting and a blanket for washing purposes.

Inquire which is the injured part and give directions for any special care necessary in lifting.

Whenever possible, the bearers should carry the stretcher to the foot of the bed or table in line with the length of the bed ; then they rest the head of the stretcher on the foot of the bed, while one of them supports the foot of the stretcher (Fig. 77). Two, or preferably four, of the bearers lift the patient up, either by means of the blanket or by joining hands underneath him from the sides ; then they step carefully sideways and lower him gently on to the bed or table.

If his condition permits, the patient is turned from side to side, slowly and carefully, while the blanket is removed.

He can be moved from one bed to another in a similar way, lifted on the lower sheet. To move him from a bed or operating-table to a stretcher, the process is reversed.

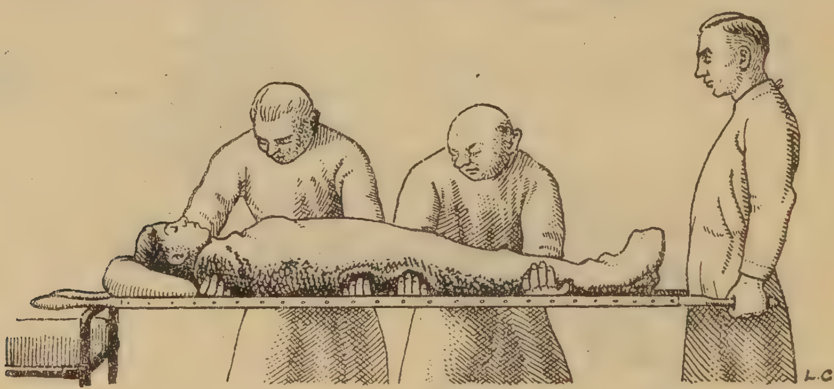


FIG. 77.—FROM STRETCHER TO BED.

When only three bearers are available, they all stand on one side of the patient. One takes the head and shoulders, the second the buttocks, and the third the legs. After rolling the patient towards them, they carry him, walking sideways, to the bed or operating-table.

A special form of stretcher with removable poles is often used for transporting a patient from the operating-table to the ward. It can be used simply as a stretcher or on a trolley. The complete stretcher, with the patient, is placed on the bed or operating-table, the poles are pulled out, and the canvas is removed by rolling the patient as described above.

319. Moving of patients in bed.—Have everything ready beforehand. In cases where the patient is permitted to help, give him any instructions as to position that may be of use.

Secure extra help when moving patients who have had abdominal operations, and those who are critically ill or suffering from injuries to the limbs.

320. Moving patients from recumbent position.—The patient may be able to help or may not.

Helpless patients.—Two orderlies are required, one on each side of the bed.

First the patient must be raised slightly to adjust the pillows. The orderly on the right side of the bed uses his right hand to grasp the patient's right upper arm ; the one on the left side uses his left hand to grasp the patient's left upper arm. He is then gently drawn forwards, and the orderlies rearrange the pillows with their free hands. (If the patient is unable to hold his head up, one orderly supports it, while the other rearranges the pillows).

To lift the patient, each orderly puts one hand under the shoulders, the hand of one man gripping the wrist of the other ; their other hands meet under the buttocks. The patient, if able, folds his arms across his chest, and draws up his knees. With their knees against the sides of the bed, the two orderlies then raise him, without jerking, to the position required.

Patient able to help.—One orderly is sufficient. He stands on the right side and places the left hand under the patient's neck or shoulders and the right round his right upper arm. The patient puts his right hand round the orderly's right arm, draws up his knees, and digs his heels into the bed. Orderly and patient make the lifting effort together.

321. To turn a patient.—The orderly stands on the side of the bed to which the patient is to turn. He flexes the patient's further knee and arm, and brings them towards him. Then he reaches across the patient, putting one hand over his shoulder and the other under his pelvis, and draws him over. If more convenient, the patient can be moved by untucking the draw-sheet on the far side, rolling it towards him, and then gently pulling him over with it.

For spinal cases two orderlies are needed to keep the head, back, pelvis and legs in line. One should take the head and shoulders, and the other the pelvis and thighs, working on the same side, and drawing the patient towards them. Great care must be taken that the spine is not twisted.

Care of the Skin

322. Bedsores.—Freedom from bedsores is a mark of good nursing, but even the utmost care cannot always prevent them in patients suffering from paralysis or spinal injuries. They are caused by :—

(*a*) *Impaired circulation.*—The patient is sometimes left too long in one position ; or pressing and bruising follow careless insertion or prolonged use of the bedpan.

(*b*) *Abrasions of the skin.*—Sometimes the skin is allowed to remain moist (insufficient drying, heavy sweating, or incontinence); or is chafed by crumbs, by wrinkles in undersheets and shirts, or by a roughened bedpan.

The parts of the body prone to bedsores are the sacrum, buttocks and hips; the shoulders, heels, elbows, knees and ankles; and the back of the head.

Prevention.—Keep a close watch for early signs of bedsores, and by frequent change of position remove any cause of pressure.

Wash the patient often with soap and water (using the palm of the hand) to promote the circulation, and dry carefully. After washing, apply spirit to harden the skin, followed by dusting powder for drying; apply both with the palm of the hand in a circular movement. Lotio zinci sulphatis (lotio rubra) may be used instead of spirit.

For cases of incontinence and patients with very dry skin, use zinc ointment, or zinc ointment with castor oil, instead of spirit, massaging the skin well.

For the knees, elbows and heels, put on a thick pad of cotton-wool and a bandage, after using the spirit and powder; a pillow under the legs lifts the heels off the bed, and a cradle takes the weight of the bedclothes.

323. Air-beds and water-beds.—These are useful because they diminish and distribute pressure.

An air-bed is laid on the top of an ordinary mattress. It should not be filled too full, or it will be hard and uncomfortable. An under-blanket is placed over the air-bed.

A water-bed is much heavier than an air-bed and is seldom used. First place a full-length fracture board on the bedstead, with a mattress over it; cover it with a long makintosh and under-blanket; then put the empty water-bed in position. After expelling the air, fill the water-bed with water at 100° F. using a jug or funnel. It must not be filled too full, and it must be emptied before any attempt is made to move it.

To test whether an air-bed or water-bed is full enough, the orderly can either lie down on it, or press it firmly with both elbows (about a foot apart).

The blankets which lie between the patient and the air-bed or water-bed need changing from time to time, as they become damp from sweat. Clean the beds thoroughly after use, and be careful not to damage them with pins.

324. Air-rings.—An air-ring is a great comfort if properly filled with just enough air to prevent pressure from the bed. A separate cover should be provided if possible; otherwise the ring should be put under the draw-sheet.

Bedpans and Urine Bottles

325. It is one of the duties of a nursing orderly to bring the bedpan and the urine bottle when required.

326. Bedpans.—Three kinds are in general use :—

The *round* is made either of earthenware or enamel and has a hollow handle for emptying. Because of its shape it is easily cleaned.

The *slipper* is the best shape for abdominal cases and others which cannot be lifted. It, too, is made of earthenware or enamel.

The *Perfection* is an improved pattern, more comfortable for the patient and easily cleaned.

The patient's bed must be enclosed in screens before the bedpan is given.

To insert the bedpan, raise the patient's pelvis by putting the left hand under his back, and with the right hand place the pan carefully in position. For helpless or abdominal operation cases help is needed.

To remove the bedpan, raise the patient as for insertion, or, if easier, roll him away from you. Perform the toilet if he is unable to do so. Toilet paper is normally used ; but tow, followed by washing, is best for infectious and helpless patients. Absorbent wool is used for rectal cases, and the dressing is done afterwards.

Toilet paper should be removed in the bedpan. Tow and wool should be put into a separate bowl containing disinfectant powder, and disposed of with soiled dressings.

Never keep a patient waiting for a bedpan, and always remove it as soon as he has finished. Always give the bedpan dry and warm, and carry it covered with a washable cloth. A bedpan should always be covered after use, to prevent flies gaining access to the contents. In cases of intestinal infection, where this is especially important, it should be covered with a lid and handle cap. All articles for such patients should be carefully labelled.

Empty the bedpan at once, and note and report anything abnormal. If the stool is required for inspection, keep the bedpan covered in a convenient place. Otherwise all bedpans should be thoroughly flushed with cold water immediately after use, and cleansed with soap and hot water once daily. Pay special attention to the handle, if hollow, and to the underside of the rim.

327. Urinals.—These are bottle-shaped and made of glass (the easiest to clean), earthenware or enamel. Carry the urinal covered by a washable cloth ; it should be warmed

before it is given to the patient. After use, empty it as soon as possible and cleanse with cold water; thoroughly wash with soap and hot water once a day; if necessary, use soda. Urine required for inspection or testing should be placed in a special glass.

Disposal of the Dead

328. If a patient dies, proceed as follows.

Immediately, before the muscles become stiff and rigid, remove all the top bedclothes except one sheet to cover the body; but leave one pillow if required. Straighten the limbs. Close the eyes and apply pads of wet-cotton wool or lint to them to keep them shut. Close the mouth and apply an ordinary "fixed bandage" or bandage under the chin tied to the head of the bed.

One hour later wash the body from head to foot with soap and water. Plug the anus, and if necessary the nostrils, with absorbent wool. Apply clean dressings to any wounds there may be. Tie the ankles together. Brush the hair, clean the nails, and if need be shave the face. Then dress the body in a shroud and roll it in a sheet, folding over the ends of the sheet at the head and foot. Pin a label to the sheet, giving the man's name and particulars and the date.

Place a clean sheet or Union Jack over all, and remove the body from the ward as soon as possible.

CHAPTER 47

FEEDING THE PATIENT

329. Serving of food.—When meals are served in the dining-halls, the arrangements should be on the lines laid down in The Management of Soldiers' Messing, with such modifications as may be found advisable. Intelligent attention to every detail of serving food to patients, whether in bed or in the dining-halls, is an important part of a nurse's duties. Progress is often influenced by the amount of nourishment taken, and this may depend largely on the way in which it is served. Therefore meat, bacon, fish or poultry should be carefully trimmed of all excess of fat; vegetables, gravy and sauces should be served in separate vessels; beef-tea should have all floating fat skimmed off. Bread and butter should be cut in thin slices; tea must be freshly made. Meat and pudding should not be served at the same time, and water for drinking should be within easy reach.

Keep everything scrupulously clean. The cloth covering the tray or table must be spotless, the glass and plate polished and bright, and the table arrangements neat and attractive.

Take care not to spill anything when carrying the tray, and do not fill glasses too full. Hot food should be brought to the patient hot, not lukewarm ; covers must always be used. Offer only small portions to a sickly patient ; a large plateful is often refused where a small one would be eaten and enjoyed.

Never keep food in the sickroom, and take away the tray from the ward directly the meal is finished. Meals should usually come as a surprise and should not be discussed beforehand. But if a sickly patient expresses strong likes and dislikes, his wishes should be humoured.

When a patient is confined to bed, do not bring him his meal before he is ready for it. If he can feed himself, prop him up comfortably in bed, and put everything conveniently to hand. If he is helpless, he must be fed with great patience and care.

330. Feeding the patient.—Feeding should be carried out strictly in accordance with the orders of the medical officer or sister. All fluid feeds must be measured, and only the quantity ordered must be given. If a helpless patient cannot raise his head, he must be given liquid feeds from a feeding-cup.

Make sure that the patient receives the diet that he has been ordered, in the correct quantities and at the correct times ; but, unless orders to the contrary are given, a sleeping patient should not be wakened for a feed. Note the amount taken, and report any refusal or dislike of the food.

When feeding patients unable to sit up, first place a cloth below the chin ; then raise the head, unless this movement is forbidden, by slipping an arm under the pillow (Fig. 78). Use a spouted feeder, not more than three-quarters full, and give the patient time to take a breath after he has swallowed a little fluid. Never give the patient the impression that there is any hurry.

A small piece of rubber tubing fitted on the spout is sometimes useful. It should be boiled after use, and both tubing and feeder must be kept perfectly clean. Use a small bottle-brush for the spout.

When a patient is allowed unlimited fluids, a full jug, covered with a gauze cover, together with a glass, should be placed beside him. Refill the jug as soon as it is empty, and record the amount taken in 24 hours.

Visitors must not be allowed to bring food or drink without the permission of the sister. When anything is brought in she will inspect it before it is taken to the patient.

FIG. 78.—FEEDING A MAN WHO CANNOT SIT UP.

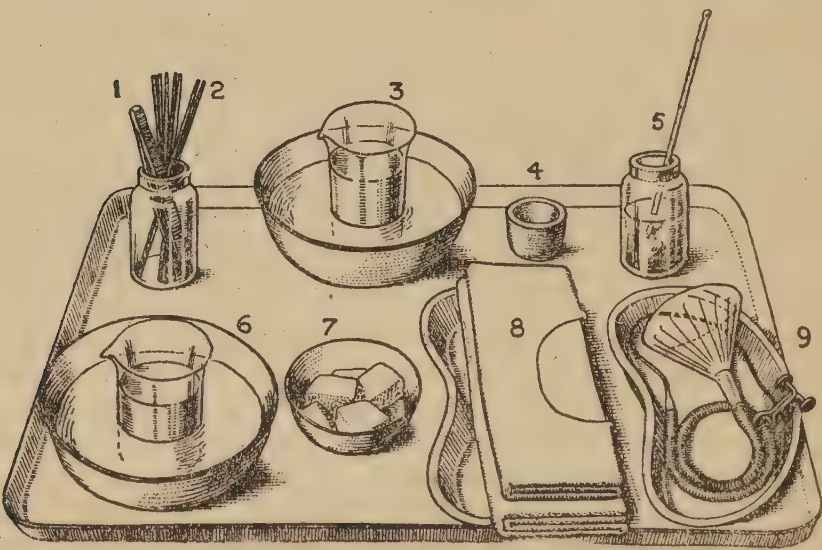


FIG. 79.—NASAL FEED.

1. Forceps
2. Orange sticks
3. Feed standing in hot water
4. Glycerin
5. Thermometer
6. Warm sterile water standing in hot water
7. Wet swabs
8. Jaconet and towel
9. Glass funnel, rubber tubing, glass connection, nasal catheter and clip.

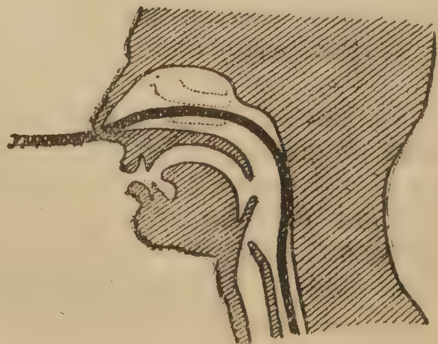


FIG. 80.—PASSAGE OF NASAL TUBE.

331. Artificial feeding.—In cases of prolonged unconsciousness, or after operation or injury involving the mouth or stomach, artificial feeding may be necessary. Nourishment can be given :—

(*a*) By the nose (nasal feeding).
(*b*) By the mouth (œsophageal feeding).
(*c*) Through an artificial opening into the stomach or intestine.
(*d*) By the rectum.

Nasal and rectal feeding are the commonest methods. In each case the bed should be enclosed by screens and the required articles brought to the bedside on a tray covered with a clean white cloth.

332. Nasal feeding.—Feeding through the nose needs great care.

Requirements (Fig. 79).—A soft rubber catheter, size 7 or 8, joined by a glass connection to a piece of tubing about 18 inches long, to which a glass funnel is attached ; a clip for the catheter ; a bowl of warm sterile water to receive the apparatus after sterilizing ; the feed, measured and standing in a jug or beaker placed in a bowl of hot water ; a lubricant, such as glycerin or liquid paraffin ; a bowl of boric lotion with swabs ; a receiver ; and some sterile water.

Method.—Place a clean cloth below the patient's chin, and cleanse the nostrils with swabs and boric lotion. Empty the feeding apparatus by holding it out of the water. Lubricate the tip of the catheter ; take hold of it, about 3 inches from the tip, with the right hand, and steady the patient's head with the left hand, then introduce the catheter into the nostril at right angles to the face—not along the line of the nose (Fig. 80). Pass it back quickly through the pharynx into the stomach, a distance of about 12 inches from the nostrils.

Wait to see whether the patient still breathes easily and regularly ; if he shows no sign of distress or discomfort, clip the tube and half-fill the funnel with sterile water. Expel the air from the tube by compressing it towards the funnel until the glass connection appears full of water and free from air-bubbles. Then release the clip and let a few drops of the water pass down. If this is satisfactory, pour the feed into the funnel and allow it to pass fairly fast. When the feed is finished, clamp the tube and withdraw it quickly. Cleanse the nose and leave the patient comfortable.

To clean the apparatus, wash it through with cold water, followed by hot water, and sterilize it by boiling. If it is in regular use it may be kept in cold sterile water or boric lotion.

The *danger* in nasal feeding is that the tube may be inserted into the larynx instead of the œsophagus. The signs of danger are coughing and difficult breathing. If these signs are observed, the tube must be withdrawn immediately.

333. Rectal feeding.—When other methods of feeding are inadvisable, rectal feeding by a nutrient enema may be ordered The amount of nourishment absorbed by this method is necessarily limited. It must be remembered that food given by the rectum does not come into contact with the digestive juices, and that therefore it is useless to give anything that cannot be absorbed by the bowel. Pre-digested foods such as peptonized milk were formerly given, but nowadays it is customary to use a solution of normal saline containing glucose, a simple form of sugar. This solution can be absorbed by the bowel, and in this way the body receives nourishment. Feeds are usually given at intervals of from 4 to 6 hours.

The apparatus used and the method of administration are as described in paras. 393 and 395.

CHAPTER 48

OBSERVATION AND REPORTS

334. Report on a patient.—Accurate and concise reports should be kept on all patients seriously ill. The following points should be noted :—

Any fresh symptoms or change in condition.
The amount and quality of sleep.
The amount, nature and times of feeds.
Medicines and treatment given, with the times of administration (and the effect if applicable).
Any nausea or vomiting.
The quantity of urine passed, with any detailed observations that may be asked for.
Number and character of stools passed.
Temperature, pulse and respiration—twice daily, four-hourly, or more often if required.
The patient's weight (when possible).

Reports of the observations made should be completed before going off duty ; they should be written in a book kept for the purpose. Any sudden or unexpected change in the patient's condition, such as collapse, severe pain or vomiting, must be reported *as soon as observed* to the medical officer or sister. Instructions for further nursing and treatment should be put in writing for the information of the relieving orderly.

335. How and what to observe.—It is wise to follow a definite routine in the observation of the sick, beginning with the general condition and passing on to the various systems as described in the following paragraphs.

Appearance of Patient

336. Position and expression.—Note carefully the appearance of the patient and his position in bed. Does he look ill or in pain? Is his expression listless, or wide-awake and anxious? Is he well-nourished or ill-nourished? Which position in bed gives him the most ease—that is, does he prefer to lie on his back, or is he obliged to sit up to breathe comfortably? Does he lie with his knees drawn up to relax the abdominal muscles, or does he lie on one side more than the other? Notice the character and the duration of any pain of which he may complain.

337. The skin, eyes and ears.—Observe the condition of the skin, whether hot and dry or moist and clammy, and whether the patient is pale, flushed, or with a bluish tinge (cyanosis) about the lips and ears. The appearance of any rash should be noted at once. Any scars, ulcers, abrasions, bruises or discolorations, and any swellings, œdema or jaundice should be reported. Note also the condition of the nails—whether discoloured, blue, clubbed, brittle or furrowed.

The eyes should be carefully watched and any irregularity in the size of the pupils, tremor of the eyeballs, tendency to squint, or other abnormality should be reported.

It is important to note any pain in, or discharge from, the ear; and in any case of head injury the escape of blood or clear fluid from the ears should be closely watched for.

The Temperature

338. Thermometers.—The temperature is taken by means of a small glass thermometer known as a *clinical thermometer* (Fig. 81). Before a patient's temperature is

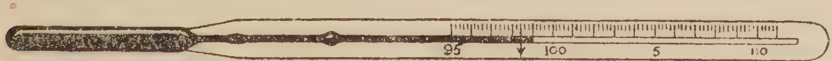


Fig. 81.—Clinical Thermometer. (The mercury shows a temperature of 99° F.)

taken, be sure that the index is set below 97° F. This is done by "shaking down" the thermometer.

The temperature can be taken in the armpit, groin, mouth or rectum. It should be taken in the morning and evening before the patient is washed. As the thermometer registers

slightly higher in the rectum than in the mouth, and higher in the mouth than in the armpit or groin, always take the temperature by putting the instrument in the same place, and at the same hour. Before taking a temperature in the armpit, wipe the skin dry; after inserting the thermometer, fold the arm across the chest to keep it in place, and leave it in position for five minutes.

When the temperature is taken in the mouth, the thermometer is inserted under the tongue, and the patient must keep his mouth shut, holding the stem with his lips. The temperature should not be taken soon after a patient has been smoking or has had anything hot or cold to drink.

When the temperature is taken in the rectum, the bulb should be smeared with soft paraffin, inserted for about an inch, and held in position. A thermometer should be specially reserved for rectal use.

After reading the temperature, shake down the thermometer, clean it, and place it in an antiseptic solution such as perchloride of mercury, 1 in 2,000, or a little methylated spirit and water. Carbolic solution should not be used, for in time it destroys the markings on the thermometer. Rinse in cold water and dry before use.

339. Fever.—The normal temperature of the body is 98·4° F. In disease it is usually above normal, but sometimes below. Patients with a temperature above normal are said to be suffering from pyrexia or fever. 102° F. denotes

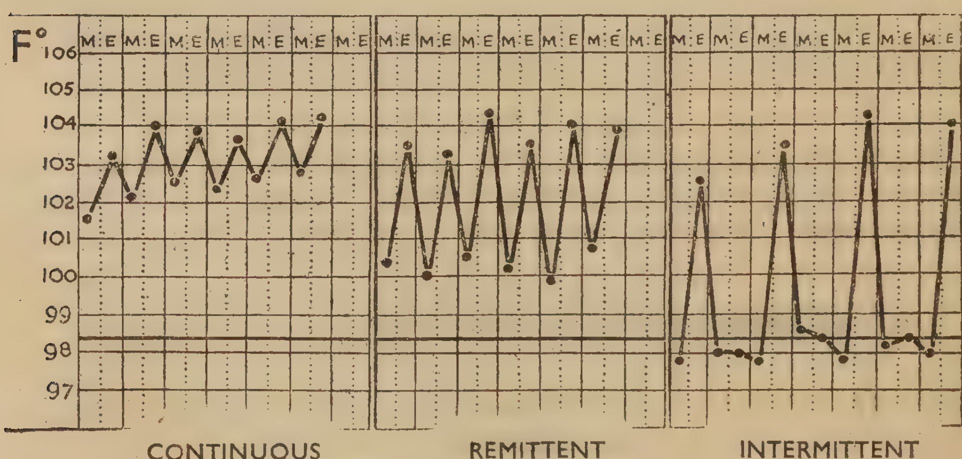


Fig. 82.—Fevers.

moderate pyrexia, 104° F. or 105° F. severe pyrexia, and 106° F. hyperpyrexia.

Pyrexia varies in character. It may be continuous, remittent or intermittent (Fig. 82). In a *continuous* fever the tem-

perature remains steadily at a high level. A *remittent* fever shows a sharp difference between the morning and evening temperature, but it never falls to normal. In an *intermittent* fever the temperature falls to normal during some part of the 24 hours.

Fever ends either by crisis or lysis. In *crisis* the temperature falls abruptly, to become normal within 12 to 24 hours; in *lysis* the descent is spread over three or four days (Fig. 83).

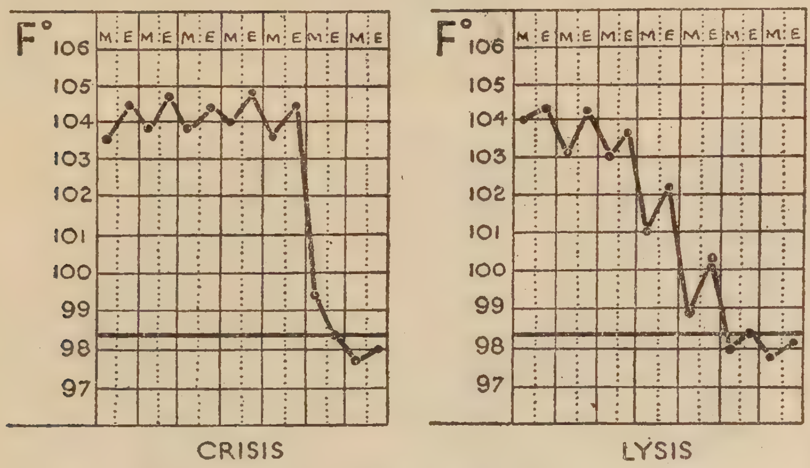
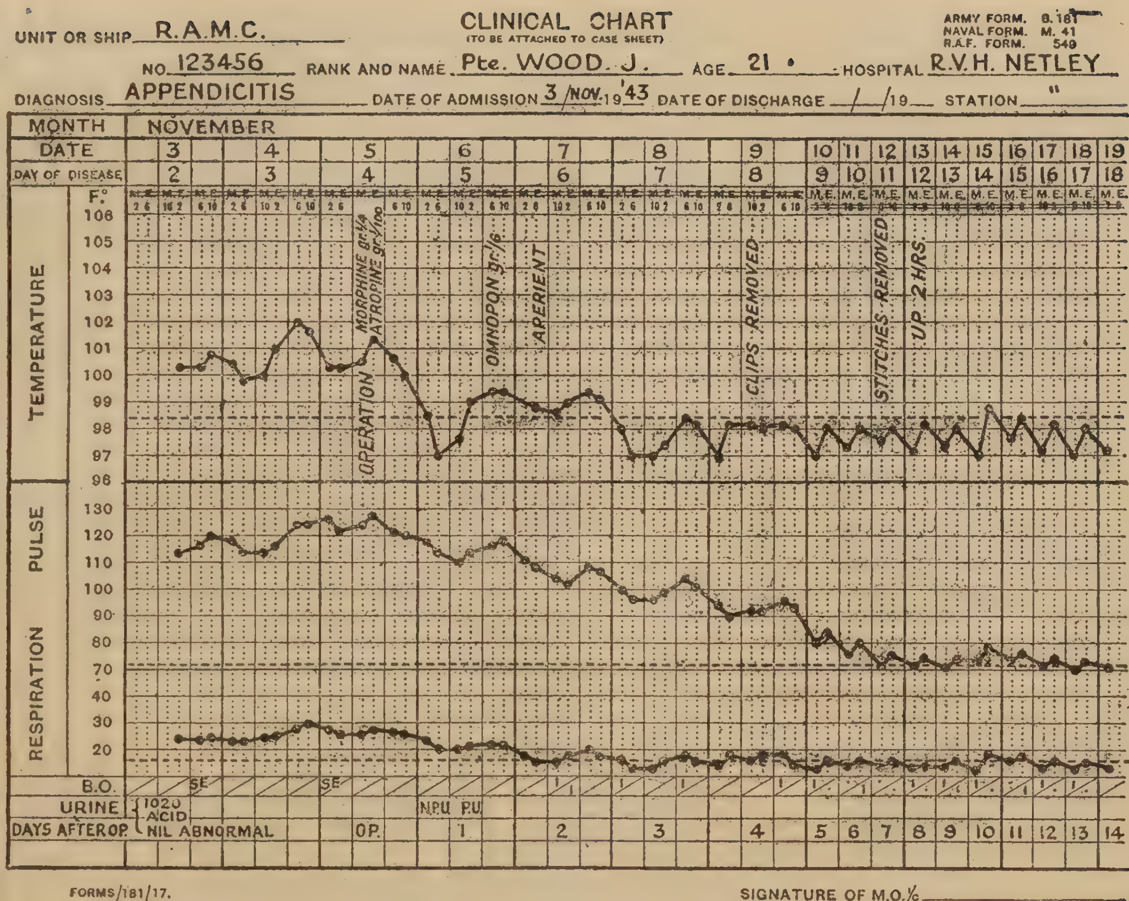


FIG. 83.—FEVER ENDING BY CRISIS AND LYSIS

The temperature must be taken at stated intervals and recorded on the temperature chart. A very high temperature is dangerous to life, and must be reported to the medical officer immediately.

Fig. 84 is an example of the kind of chart kept for hospital patients. Such a chart shows at a glance the course of the temperature and the pulse and respiration rates, and also gives other information about treatment and progress.

340. Rigors.—A rigor or shivering attack, accompanied by a rise of temperature, often marks the onset of an acute illness; it should be noted on the chart. The shivering may be only slight; or it may be very severe, with a general shaking of the body and chattering of the teeth lasting for some minutes. Take the temperature in the armpit at the beginning of the rigor; take it again as soon as the shivering ceases (when the fever is usually highest); and again a quarter of an hour later. Hot-water bottles, hot blankets and hot drinks should be given during the shivering stage; afterwards the patient sweats profusely. Rub him down with a warm towel and change his pyjamas; remove the bedclothes gradually to avoid chill. The pulse must be carefully noted for some hours after the rigor.



It will be seen that until the 8th day of the illness (4th day after operation) the temperature and pulse and respiration rates were noted four-hourly; but from then onwards twice daily (morning and evening).

Fig. 84.—Clinical Chart in a Case of Appendicitis.

The Pulse

341. The pulse is one of the most important guides to the patient's condition, for it shows whether he is gaining or losing strength. Long and painstaking practice is needed to learn to take it efficiently.

The pulse-rate in health is round about 70 beats a minute, but it varies with age and with the position of the patient. It is quicker in youth than in adult life, and nearly always slower in old age. It is quicker when standing than when sitting, slower when lying down at rest, and slowest of all when asleep. In health the pulse-rate may be increased by emotion, excitement, fear or anger.

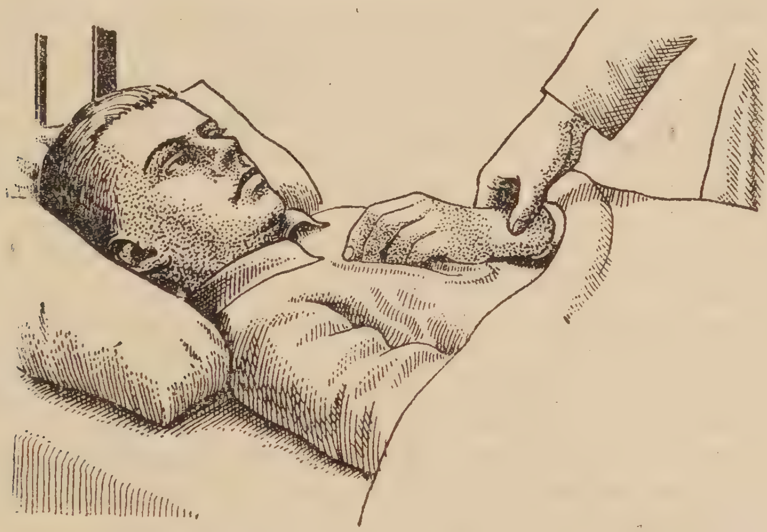


Fig. 85.—Counting the Pulse-rate and Observing the Respirations.

To count the pulse, place three fingers on the radial artery at the wrist with the patient's arm lying at rest (Fig. 85). With a sleeping patient, place the finger on the temporal artery just in front of the ear.

A normal pulse should be regular, of moderate volume, and not too easily compressed. Note all these points and report any abnormality.

A pulse which gets quicker day by day, when the temperature is stationary or falling, is a sure indication of a failing heart.

Respiratory System

342. Respiration.—The points to be observed are the frequency and character of the respiration.

Frequency.—In good health the normal rate for an adult is 14–18 respirations a minute. (As the normal pulse-rate is about 70 a minute, the ratio of respiration to pulse is roughly 1 to 4). The rate may be increased by exercise or emotion; it is decreased during rest and sleep. In many diseases of the lungs or air-passages the rate is increased, sometimes to as much as 90 a minute; it falls in injuries to the brain and after taking narcotic drugs, such as opium.

The patient should never know that his respirations are being counted; for, if he is conscious of it, he may unintentionally alter their frequency. The best plan is quietly to count the movements of the chest after taking the pulse, without removing the fingers from the wrist (Fig. 85).

Character.—It is important to note whether the respiration is regular or irregular, easy or laboured, quiet or stertorous (snoring). Difficult breathing is called *dyspnoea*, which may be slight or severe. With this condition there is usually cyanosis or blueness of the lips and skin, due to lack of oxygen in the blood.

343. Cough.—The points to note about a cough are its frequency, duration and character.

Sputum.—Expectoration varies in different diseases, and at different times in the same disease. Note the quantity, and measure it for 24 hours if it seems excessive. Observe the odour, colour and consistence (whether it is thick, watery or tenacious); also look for blood. A few streaks or specks of blood from a severe bout of coughing are probably of little or no importance; but enough to give the sputum a rusty colour may be a sign of pneumonia. In cases of tuberculosis, or of injury to the lung, large quantities of bright and sometimes frothy blood, either fluid or clotted, may be coughed up. This is known as *hæmoptysis*.

The Digestive System

344. The mouth and throat.—Note the presence of sordes (accumulations of dried secretions) on the lips, teeth and tongue. See whether the tongue is tremulous or not, whether clean or furred, dry or moist; also whether any ulcers are present. Note any difficulty in swallowing, soreness of the throat, or enlargement of tonsils; symptoms of indigestion such as flatulence, heartburn, pain or nausea after food; and any abdominal pain or distension.

345. Vomit.—If there is any vomiting, note the quantity, colour, consistence and odour of the vomit, and the time at

which it occurs in relation to food or medicine. The vomiting of blood is known as *hæmatemesis*. When blood has remained for some time in the stomach, it is partly digested and may look like coffee-grounds.

Nervous System

346. Fits are common in epilepsy, but they are often seen in other diseases of the brain and sometimes in diseases of the kidney. The points to be noted during a fit are :—

- The onset—whether gradual or sudden, and whether any part of the body is affected first.
- Whether the patient loses consciousness or not.
- The colour of the face—whether pale, flushed or cyanosed.
- Whether the tongue or the lips are bitten, and whether there is any frothing at the mouth.
- Whether there is incontinence of urine or fæces.
- Whether the patient is quiet, or talkative and noisy.
- Whether the pupils are dilated, contracted or unequal.
- Whether there is loss of power in any limb during or after the fit.
- Whether restraint is necessary.
- Whether the end of the fit is gradual or sudden, and whether there are any symptoms afterwards.

A patient in a fit must never be left alone. Take care that he does not injure himself (para. 194).

347. Delirium.—When a patient is delirious note whether the delirium is low and muttering, or active and noisy ; and whether it is more pronounced at any special time. Picking at the bedclothes is a bad sign ; it must be noted in the report.

348. Sleep.—Note how long the patient sleeps, and whether his sleep is disturbed, or sound and calm. To encourage sleep the room should be darkened, and the light shaded from the patient's eyes. A drink of warm milk is helpful, if this is not contrary to instructions. Sponge the face and hands, rearrange the pillows, and place a hot bottle at the feet if required.

349. Mental disorders.—In mental cases special information is needed, which must be carefully recorded. General appearance and behaviour, clothing and habits, speech and intelligence, sleep and restlessness are all points to be noted ; also any hallucinations, illusions, delusions, fears (often of persecution), emotional disturbances, excitement and depression. Such information will help the medical officer in making a diagnosis.

350. Stools.—The points to be observed are :—

(*a*) Shape, colour, form, consistence and amount.
(*b*) Presence of blood, mucus, pus, undigested food, worms or foreign bodies.
(*c*) Frequency of motion.
(*d*) Difficulty or pain in passing stool.

Anything unusual should be kept for inspection.

351. Urine.—Note the quantity, colour, clearness and odour ; and whether there is any difficulty or pain in passing water. If anything abnormal is noticed, the urine should be kept. Note the frequency and time of micturition.

The patient may be unable to pass water. This condition is called *retention* of urine ; it should not be confused with *suppression* of urine, when no urine is secreted by the kidneys.

CHAPTER 49

REMEDIES AND THEIR ADMINISTRATION

352. Since prehistoric times mankind has been searching for ways of checking disease and making sick people comfortable. The number of remedies invented or devised is enormous, but they mostly fall into two main groups. First there are the *internal remedies*, including all the many drugs that can be put into the body to alter its condition. Secondly there are the *external remedies*, including various means of applying heat and cold and other agents to the outside of the body so as to relieve pain, lower fever or hasten healing.

This chapter deals briefly with internal remedies : though these are mainly the concern of the medical officer, the nursing orderly must be familiar with their administration. The three following chapters describe in more detail the principal methods of external treatment. These may be just as important as drugs, and their success depends very largely on nursing skill.

353. Use of drugs.—Medicines or drugs are substances given to restore or to improve health. They may be given in solution, from a bottle ; as pills or tablets ; as ointments, liniments, or inhalations ; by injection ; and in several other ways.

Some medicines, such as extracts of thyroid gland or liver or pancreas (insulin), are derived from animal sources. Others, such as the heart stimulant digitalis, which comes from the foxglove, are made from plants. Others again, such as calomel,

are mineral. And finally many of the most modern drugs, such as the sulphonamides and mepacrine, have been invented by chemists and are made in laboratories.

People are not always affected by drugs in the same way. For instance one man may be able to take large doses of quinine without any bad effect, whereas another complains of headache and buzzing in the ears after quite a small dose. The man who gets these symptoms is said to have an *idiosyncrasy* for quinine. Doctors have to be careful about such personal idiosyncrasies in prescribing the more potent drugs.

The body gets rid of some drugs quickly, others slowly. When elimination is slow, each fresh dose increases the amount remaining in the body from previous doses, until there is such an accumulation that it begins to poison the system. This is called *cumulative effect.* Arsenic provides a well-known example. Doctors seldom give this drug for more than three consecutive weeks; after that they stop it for a time so that the body may get rid of all that has accumulated.

Many drugs gradually lose their influence on a person who has been taking them for a long time. He then needs larger doses to produce the original effect. This is called *increased tolerance.* The detective, Sherlock Holmes, who often injected morphine into his arm, would have acquired increased tolerance.

354. Classification of drugs.—Drugs may be classified according to their purpose and mode of action. For example, there are :—

Anæsthetics, which remove all sensation, either in the whole body (chloroform, ether) or locally (procaine).
Analgesics, which remove pain (aspirin, morphine).
Antipyretics, which reduce fever (aspirin).
Diuretics, which increase the flow of urine (caffeine).
Expectorants, which promote coughing to clear the chest (squill).
Hypnotics or narcotics, which induce sleep (chloral, morphine).
Purgatives, which stimulate action of the bowels (castor oil, calomel, Epsom salts).
Sedatives, which soothe the nervous system (bromide, phenobarbitone).

355. Ways of giving drugs.—Internal remedies may be administered :—

(*a*) *By the mouth* (oral administration), in liquid form as mixtures, tinctures and solutions, or in solid form as pills, tablets and capsules.

(*b*) *By hypodermic* (*subcutaneous*) *injection* (beneath the skin) through a hollow needle inserted obliquely. Action is more rapid than when the drug is given by the mouth. Morphine is usually given in this way.

(*c*) *By intramuscular injection* (within a muscle), when the hollow needle is plunged deeply into a selected muscle. This method is often employed when injections of larger volume have to be given.

(*d*) *By intravenous injection* (within a vein). The drug is very rapidly and fully absorbed, since it passes direct into the blood-stream.

(*e*) *By intravenous drip or infusion.*—The needle is left in the vein and the remedy is allowed to flow through it very slowly—perhaps for hours.

(*f*) *By intraspinal injection* (into the spinal canal). The needle is inserted between two vertebrae in the lumbar region (lumbar puncture).

(*g*) *Per rectum*, either by running the fluid into the rectum through a soft rubber tube (enema), or by inserting the drug in the form of a suppository, shaped like a soft-nosed bullet, which easily dissolves.

(*h*) *By inhalation* (or breathing in). Oxygen is given through a tube or mask. Amyl nitrite is a liquid drug encased in a capsule ; when the capsule is broken under the patient's nostrils, fumes from the liquid are inhaled.

Certain internal remedies are applied externally to the skin. For example, instead of giving mercury by mouth or by injection, it may be rubbed into the skin (inunction), which absorbs it. Or a medicated bath can be given so that the remedy will be taken in through the skin. In the same way some drugs are absorbed into the eye when dropped on its surface.

356. Weights and measures.—Since it is necessary to measure doses accurately, and often in very small amounts, special weights and measures were devised by the old-time apothecaries. Many of these are still employed.

Fluids.—An orderly will most often use the fluid measures. Measuring glasses of various sizes are issued ; the smallest, the minim glass, is very narrow, so that a small quantity of fluid can be read easily on the scale marked on the glass.

minims (or drops) = 1 fluid drachm (ʒi) = one teaspoonful.
8 drachms = 1 fluid ounce (℥i) = two tablespoonfuls.
20 ounces = 1 pint (Oi) = two tumblerfuls.

Solids.—These are generally weighed by the dispenser on delicate scales.

60 grains (gr. 60 or 60 grs.) = 1 drachm.
8 drachms = 1 ounce (oz.).
16 ounces = 1 pound (lb.).

Metric measures.—The doses of many of the newer drugs are stated according to the metric system, which is simpler and is international. For fluids the unit is a cubic centimetre (1·0 c.cm.) and for solids the unit is a gramme. The principal weights and measures are :—

1,000 milligrammes (1,000 mg.) = 1 gramme (1·0 g. or 1·0 gm.)
1,000 grammes = 1 kilogramme (1 kg.) (about $2\frac{1}{5}$ lb.).
1,000 cubic centimetres (1,000 c.cm.) = 1 litre (about $1\frac{3}{4}$ pints).

One gramme is about the same weight as 15 grains ; so when the abbreviation " gr." is used it is important to be sure whether grammes or grains are meant.

357. Prescriptions.—A prescription for medicine is like a recipe for cooking. By old custom the doctor often writes it in Latin, but to save time the Latin words are not written in full. At the end of the prescription he should write " Sig." —short for " signetur ", meaning " let it be written ", followed by the instructions, in English, which are to be written on the label of the bottle. But sometimes he (wrongly) uses Latin abbreviations for this, and the simplest ones should be learnt. These are :—

t.d.s. or t.i.d. = three times a day.
b.d. = twice a day.
a.c. = before food.
p.c. = after food.
p.r. = per rectum.

The commonest instruction is t.d.s., p.c.

The label should also show whether the medicine is to be taken in water or not. Unless otherwise ordered, it is usually taken with an equal amount of water.

358. Administration of medicines.—The following rules should be observed :—

(*a*) Medicines must be given punctually as ordered.
(*b*) Never give a double dose because the previous dose has been missed.
(*c*) Medicines to be given by mouth must be kept separate from lotions and liniments.
(*d*) All poisons must be kept in a separate cupboard.

To give medicine from a bottle (Fig. 86) :—

(*a*) Read the label before and after measuring the dose.
(*b*) Shake the bottle well, turning it upside down and keeping the first finger on the cork.
(*c*) When pouring the medicine into the measure glass, hold the bottle label upwards, so that no drip will fall on the label. Keep the measure glass level with the eyes and catch the last drip in the glass.
(*d*) Measure with a measure glass, not with a spoon.
(*e*) Wash the medicine glass at once ; later it is more difficult.

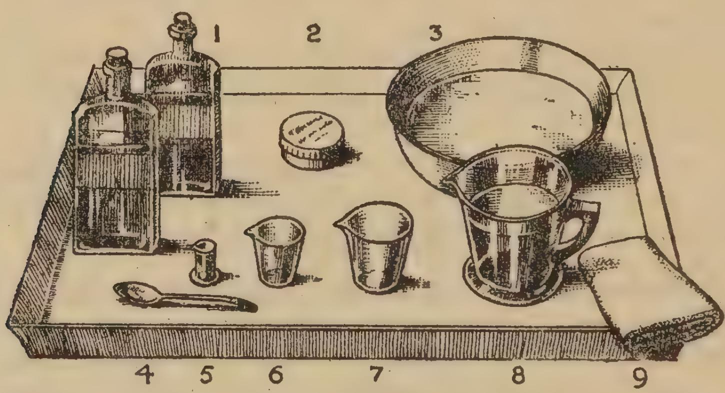


FIG. 86.—MEDICINE TRAY.

1. Medicine
2. Tablets
3. Warm water
4. Spoon
5. Drachm measure
6. 2-oz. measure
7. 4-oz. measure
8. Cold water
9. Medicine cloth

Pills and tablets are placed on the tongue and swallowed with water. Powders are best dissolved, or stirred, in water.

Many medicines are unpleasant to take ; a dose may be followed by a glass of water and a piece of bread.

Castor oil may be given thus. Warm the glass with hot water. Pour in some orange or lemon juice, or brandy, also smearing it inside the edge of the glass. Pour in the oil carefully, trying not to let it touch the side of the glass. The oil should remain in the centre of the liquid. The patient then empties the glass with a bold no heel-tap, and does not taste the oil.

Croton oil tastes even worse, although the dose is small. One or two minims are dropped into a hole in a small pat of butter or margarine. This is laid on the handle of a spoon, by means of which it is placed on the back of the tongue.

Medicines administered by hypodermic, intramuscular, intravenous or intraspinal injection are not in ordinary circumstances given by nursing orderlies. The requirements for a hypodermic injection are shown in Fig. 87.

Times of administration.—Medicines ordered three times a day are given at 10.00, 14.00 and 18.00 hours; those twice a day at 10.00 and 18.00 hours. Those to be taken before food are given 15 minutes before a meal; after food means immediately after.

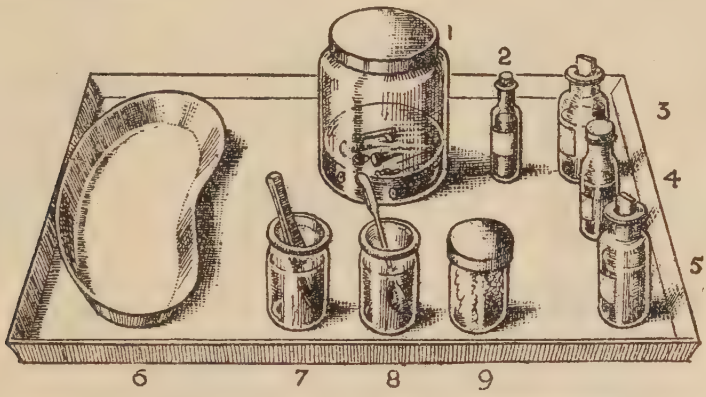


FIG. 87.—HYPODERMIC INJECTION.

1. Needles and syringes in methylated spirit
2. Collodion
3. Surgical spirit
4. Iodine
5. Sterile water
6. Dish for swabs
7. Forceps in antiseptic
8. Spoon in antiseptic
9. Dry sterile cotton-wool.

Medicines to be taken 4-hourly (once every 4 hours) must be given punctually; they are given by night as well as by day; the sister or medical officer decides whether the patient is to be wakened or not.

Most aperient (laxative or purgative) medicines are given in the evening, but saline aperients before breakfast. Sleeping draughts are given last thing at night.

359. Administration of oxygen.—Oxygen is given for the relief of air-hunger or asphyxia, which in medical cases is often due to illness affecting the heart or lungs. Patients needing oxygen usually show blueness of the lips and ears (*cyanosis*), perhaps with panting or difficulty in breathing (*dyspnœa*).

Oxygen is given through the nose, either by a nasal catheter or by a B.L.B. mask (Fig. 88), which is specially designed for the purpose.* The mouth is thus left free for feeding or for expectoration.

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* The letters B.L.B. stand for the names of three inventors of the mask.

A flow meter must always be used, so that the amount of oxygen inhaled may be known. New cylinders should be tested outside the ward, and their markings should be checked against those shown in the instructions in Regulations for the Medical Services of the Army, 1938, App. 53.

FIG. 88.—ADMINISTRATION OF OXYGEN BY NASAL CATHETER (LEFT), AND B.L.B. MASK (RIGHT).

CHAPTER 50

LOCAL APPLICATIONS

360. Cold and heat, appropriately employed, can be very valuable remedies. This chapter describes some of the ways in which they are applied locally—that is to say, to a part of the body rather than the whole. It also describes the use of other local remedies, including counter-irritation, leeches, ointments, gargles, inhalations, and drops or lotions for the eye and ear.

COLD

361. Cold relieves pain and congestion by reducing the supply of blood to a part. It is used to lessen swelling and sometimes to check bleeding.

362. Cold compresses and dressings.—To make a *cold compress,* a single fold of lint is squeezed out of cold or iced water and applied to the part, which is kept cool by evaporation of the water. The compress is changed as soon as it becomes warm. Two pieces of lint are required, one on the part and the other in iced water ready for use. If a limb is to be treated, it is placed on a pillow, protected by a mackintosh cover, and

a cradle is put over it to allow exposure to the air and evaporation.

Evaporating lotion may take the place of the water used with a cold compress. The lotion may consist of methylated spirit or eau-de-cologne, 1 part to 3 parts of iced water. Lead lotion is commonly used. The bowl of lotion should be kept covered with jaconet to prevent evaporation.

Cold moist dressing.—A double fold of lint is squeezed out of iced water, covered with a piece of jaconet slightly larger all round, and lightly bandaged in position. The lint must be changed often if the application is to be kept cold.

363. Ice-bags.—These are made in various shapes and sizes to suit the part to which they are applied. The cup-shaped ice-bag is the one generally used. It should be half-filled with small pieces of ice, sprinkled with salt to assist

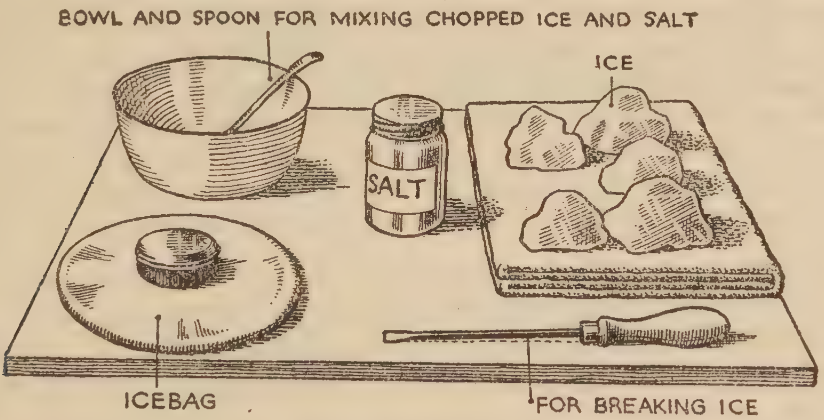

FIG. 89.—ICE BAG.

freezing; and the air should be expelled. Ice-bags are refilled every two hours or when the ice has melted. A single layer of lint is placed between the ice-bag and the skin, and the bag is usually suspended from a cradle or similar apparatus so that its whole weight shall not fall on the affected part. (Fig. 89).

364. Ice poultice.—Requirements: jaconet or gutta-percha tissue, salt, cotton-wool, ice, chloroform and a paint-brush.

Cut the jaconet double the size of the required poultice and fold it in half. Cover one half with a thin layer of cotton-wool, and over this place small pieces of ice. Sprinkle some salt over the ice, cover with another layer of cotton-wool, and finally with the second half of the jaconet. Moisten the edges with the brush, dipped in a little chloroform, and seal the poultice by pressing them together. Apply over a layer of lint, and bandage in position.

Heat

365. Heat increases the supply of blood to a part, thus helping to combat infection. It may also relieve pain.

366. Dry heat.—Hot-water bottles are a simple form of hot dry application. They are made of tin, earthenware, or rubber, and should have thick flannel covers. For the feet, tin or earthenware bottles are suitable ; for any other part of the body a rubber bag is more comfortable and efficacious. The water should be just off the boil, and the stopper must be screwed in tightly. Rubber bottles should not be more than three-quarters full, and air should be expelled before the stopper is replaced.

Great care must be taken not to burn the patient : those who are unconscious ; the paralysed ; those who are suffering great pain ; the dropsical ; the very young ; the old—all these are particularly liable to be burnt. Patients have sustained serious and crippling burns because they were not properly protected from contact with very hot bottles—especially when returned to bed after an operation, while they were still under the influence of an anæsthetic.

Electric pads.—Compared with hot bottles, these have the advantage that they remain at the same temperature. They are enclosed in washable covers. Here again care must be taken to avoid burns. The heat is controlled by the regulating switch.

367. Fomentations.—A fomentation is an application of moist heat. If there is no wound it is called a *medical fomentation* ; if applied to a wound, a *surgical fomentation* (which must be sterile). If drugs are added to a fomentation, it is called a *medicated fomentation* or *stupe*. The best material for a stupe is fomentation flannel ; lint or absorbent wool can also be used.

To prepare a fomentation, place the flannel or lint inside a towel or wringer, and lay this across a heated bowl, with the ends projecting over the sides (Fig. 90). Pour on boiling water ; wring out the flannel in the towel until it is as dry as possible (Fig. 91) ; take it out of the towel, and apply it as hot as the patient can bear. (The secret of success is to get it very dry.) Cover with jaconet and cotton-wool, overlapping the flannel by half an inch all round, and bandage firmly in position. A fomentation for the relief of pain should be changed at least every half-hour, but should not be continued if there are signs that the skin is scalded.

Turpentine stupe.—Sprinkle one or two teaspoonfuls of turpentine on the flannel *before* it is wrung out.

Opium or belladonna stupe.—Sprinkle half a teaspoonful of tincture of opium or tincture of belladonna on the flannel *after* it has been wrung out.

FIG. 90.—FOMENTATION.

1. Flannel folded in wringer
2. Kettle of hot water
3. Cotton-wool
4. Bandage
5. Kidney dish
6. Towel to protect bed
7. Jaconet to cover fomentation

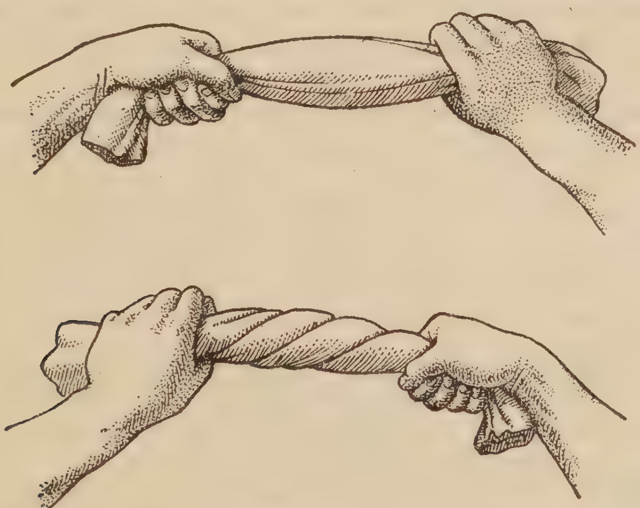

FIG. 91.—WRINGING OUT THE FOMENTATION.

368. Poultices.—A poultice is another form of moist heat. The poultice most often used is made of kaolin, or china clay. This has largely taken the place of the linseed poultice, because it is lighter and holds the heat longer.

Kaolin poultice (Antiphlogistine).—Heat the preparation by standing the tin in boiling water. When hot, spread thickly

on lint, and apply ; cover with warmed wool, and bandage in position. The poultice should be renewed after 6 to 8 hours, for it becomes dry and uncomfortable. Care must be taken not to over-heat the kaolin, because it is sticky and, if applied too hot, will adhere to the skin and burn the patient before it can be removed. As a precaution against this happening, the surface of the poultice should be covered with a thin layer of gauze.

Linseed poultice.—Crushed linseed is used. A board, a bowl, two enamel plates or trays, a kettle, a jug of boiling water and a large spatula or flat knife are required ; also tow or linen on which to spread the poultice. If tow is used it must be teazed out flat and even to the required size.

Prepare, but do not expose the patient ; also heat all utensils and warm the linseed beforehand, for the poultice has to be made quickly. Pour enough boiling water from the kettle into the bowl, and sprinkle in the linseed with one hand, stirring with a spatula held in the other. When enough linseed has been added, the mixture will come away cleanly from the side of the bowl. Turn it out on to the linen or tow, and spread it evenly and quickly with the spatula, which should be dipped in the jug of boiling water between each stroke. The layer of linseed should be $\frac{1}{4}$ inch thick, and it should extend to within 1 inch of the edge of the linen or tow. Finally the edge of the linen is folded over ; or the tow is rolled in all round.

Carry the poultice between two hot enamel plates to the bedside, apply it, cover it with a thick layer of cotton-wool, and secure it with a bandage. (Before application, test the heat of the poultice on the back of your hand, so as not to put it on too hot.) When taking off a poultice, put a little warm olive oil or liquid paraffin on the skin to remove any particles of linseed ; then apply a layer of warmed cotton-wool.

Mustard poultice.—Mustard is sometimes added to a linseed poultice to produce a stronger effect. To avoid blistering, raise the corner of the poultice after 10 or 15 minutes, and note the degree of reddening of the skin.

The mustard is either well mixed with the linseed *when dry* or made with tepid water into a thin paste, which is added to the boiling water to be used for mixing the linseed. The proportion should be not more than 1 part mustard to 6 parts linseed for an adult (less for a child).

When removing a mustard poultice, if the skin is very red, apply a little warm olive oil or liquid paraffin before covering with cotton-wool.

Starch poultice.—This is used to remove crusts and scabs

in certain skin affections. Requirements: starch, boracic powder, cold water, linen or gauze, and a spatula.

Take four tablespoonfuls of white starch; add one teaspoonful of boracic powder, and enough cold water to make a thick even paste. Pour on half a pint of boiling water, stirring continuously until the starch is stiff. Leave until cool, and then spread thickly on the linen or lint. Apply and secure with a bandage.

Counter-Irritation

369. Counter-irritation is a method of relieving pain or checking inflammation. Some counter-irritants cause mere reddening of the skin, others actual blistering. They act by stimulating the nerve-endings in the skin; this increases the circulation in the skin and may thus reduce congestion in the deeper tissues beneath.

370. Iodine.—The skin must be dry. Strong tincture of iodine is painted on with a brush or a piece of cotton-wool. When it is dry, a second application is made, and the part is covered with lint and a bandage.

371. Liniments.—These are applied by rubbing. Take a little liniment on the palm of the hand, and rub it into the skin over the affected area, using the whole hand flat. (When rubbing a limb follow the direction of lymph circulation—from below upwards). Continue to rub until the part is warmed and the skin reddened by the friction.

372.—Mustard applications.—Mustard leaves and mustard plasters are used.

Mustard leaf.—The skin is cleansed with soap and water, and the mustard leaf, moistened in warm water, is applied and kept in place with a piece of lint and a light bandage. Remove as soon as the skin is reddened and the patient complains of pain from burning. Dust the skin with dusting powder and cover it with cotton-wool or dry lint. The mustard leaf should never be left on long enough to cause blistering.

Mustard plaster.—Mix two parts of mustard with one of flour; add cold water to make a smooth paste; spread on lint, cover with gauze, and apply in the same way as a poultice. Hot water should not be used, for it destroys the properties of the mustard. The plaster should be removed as soon as the skin is definitely reddened; the mustard must not be allowed to raise a blister.

373. Scott's dressing.—This is applied chiefly to joints containing an excess of fluid—for example, a knee swollen after a twist or blow. Requirements: Scott's dressing (a compound mercury ointment), white lint, scissors, strapping, a spatula and a bandage.

Cut strips of white lint $1\frac{1}{2}$ inches wide, and 3 inches longer than the circumference of the limb, and cut similar strips of strapping. Spread the ointment thickly on the smooth side of the lint with the spatula. Wash and shave the limb. Apply the first strip to the back of the limb 2 inches below the joint, bringing the ends round to cross over in front; take the second strip and apply in the same way, overlapping the upper edge of the first; continue until the joint is covered, and then apply the strips of strapping in the same manner. The strips should overlap each other by about $\frac{1}{4}$ inch. Put on a firm bandage and leave for two or three days.

374. Blisters.—Blistering of the skin may be produced either with blistering plaster or blistering fluid.

Blistering plaster.—Wash, and if necessary shave, the area to be blistered. Cut out the required size of plaster, and apply it to the skin, securing it with a light bandage. It should be left on for 10 to 12 hours. When the blister has appeared, remove the plaster with the aid of a little olive oil if necessary. Snip the blister at its lower edge with a pair of sterilized scissors and take up the escaping fluid with a sterile swab. Apply a dressing, cotton-wool and a light bandage.

Blistering fluid.—Apply the fluid only to the area of skin to be blistered, protecting the surrounding skin with soft paraffin. Wait until the skin is dry, and then cover with lint or gauze and a light bandage. When the blister appears, snip it and dress it as described above.

Leeches

375. Application of leeches.—Leeches are used for the relief of pain and to check inflammation. They are small, slimy animals, resembling slugs, and each can draw off from 1 to 3 drachms of blood at a time. The small pointed end is the head. Leeches should be handled as little as possible.

First wash and thoroughly dry the skin; then rub it briskly, if possible, to bring the blood to the surface. Cover it with a piece of lint or linen with a small hole cut in the centre. The lint protects the skin from the body of the leech; the hole is cut to allow the leech to bite through it.

With a blunt glass rod transfer a leech, head upwards, to a test-tube two-thirds filled with cotton-wool, and invert the

tube over the hole in the lint. If the leech refuses to bite, prick the skin with a sterilized needle to draw a drop of blood.

A leech continues to suck blood for about three-quarters of an hour. Then it usually falls off; if not, a pinch of salt on its head will make it let go. It must not be forcibly removed lest its teeth be left embedded in the skin, producing a troublesome wound. The leech is now placed in a bowl or jar of cold water containing a little salt, where it vomits up the blood it has taken. Thence it is moved into a bottle of plain cold water securely covered with gauze.

The site of the leech bites is covered with a pad of gauze held by strapping; unless further bleeding is desired, when a fomentation is applied. Troublesome bleeding may follow leech bites: it can usually be controlled by firm pressure, but the medical officer must be informed if it persists.

Leeches should not be applied over large blood-vessels; or over unsupported soft tissues, such as the scrotum; or near openings, such as the ears or nostrils, which they might enter, unless these openings have been plugged with cotton-wool. Special care must be taken if they are put near the anus.

Ointments

376. Ointments.—Ointments may be applied direct (*e.g.* to the eyelid or conjunctiva), or may be spread evenly on the smooth side of lint, or may be rubbed in with the hand (inunction).

Inunction.—The area selected should be cleansed with hot water and soap, and if necessary shaved. The ointment is warmed before use.

Mercury is sometimes administered by inunction. Mercurial ointments are poisonous, and, if the patient cannot carry out his own inunction, the attendant giving it should wear a rubber glove. If this is not available, a flat glass stopper can be used as a rubber. It is essential that the inunction should be thorough. The ointment should be rubbed in for about half an hour until the skin is no longer sticky. The treatment is carried out daily over the prescribed period; a different area is chosen each day.

Gargles and Inhalations

377. Gargles.—A gargle is given either warm or cold, with or without water, as ordered. The patient takes a mouthful, throws his head back, and allows the gargle to run to the back of the throat; he then breathes out gently through the mouth, making the fluid bubble in his throat. In due course he spits it out, and repeats the process until the gargle is finished. None of it should be swallowed.

378. Painting the throat.—Requirements: a swab-holder or Spencer Wells forceps; a tongue-depressor; small cotton-wool swabs; throat paint; a receiver; and, if necessary, a torch or other light.

If able to sit up, the patient should face the light; otherwise a torch should be used to illuminate the throat. Hold down the tongue gently with the tongue-depressor. Using a swab firmly held in the swab-holder or forceps, paint the throat quickly but gently. If more than one application is needed, use a fresh swab each time. Substances commonly used for painting are iodine paint 5 per cent.; glycerin and tannic acid; carbolic lotion (1 in 60); Mandl's paint.

379. Steam inhalations.—These are often ordered in cases of bronchitis and sinusitis. The steam may or may not be impregnated with some drug: menthol (2 or 3 crystals), eucalyptus (5 to 10 drops), and friar's balsam (tinct. benzoin. co.) $\frac{1}{2}$ to 1 drachm in one pint of water, are those most commonly employed. A Nelson's inhaler or a large jug can be used for the inhalation (Fig. 92).

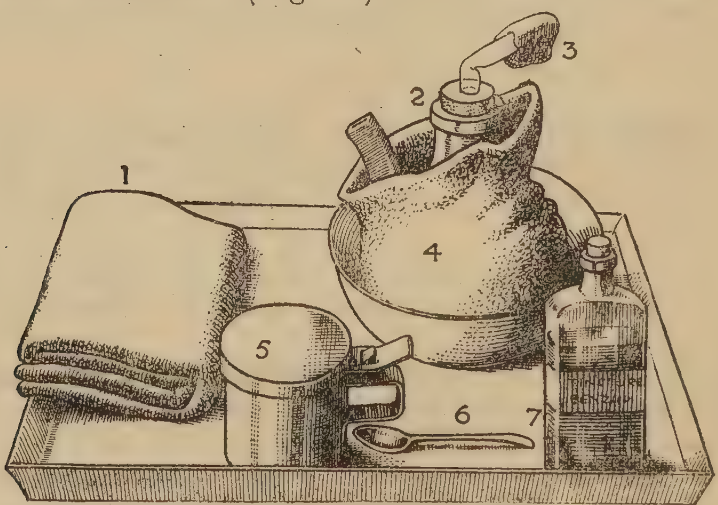

FIG. 92.—INHALATION.

1. Small blanket
2. Nelson inhaler
3. Gauze
4. Towel
5. Sputum mug.
6. Spoon
7. Inhalant

Thoroughly heat the inhaler with boiling water; empty this out and put in the prescribed dose of the drug; fill the inhaler half-full of boiling water and put a towel round it to prevent burning the hands. The patient is told to breathe in through the mouth the steam given off by the mouthpiece, and breathe it out through the nose.

If a jug is used, a towel should be placed over the patient's head to prevent the escape of steam.

The Eye

380. Applications to the eye.—*Eye lotions* are applied from a special glass vessel called an *undine*, and drops are inserted in the eye from a sterile glass rod or pipette. Unless the eye has been injured, the upper and lower lids should be partly turned back to facilitate introduction of the lotions.

Stand behind the patient, who sits in a chair with his head thrown back and his clothing protected by a towel. A receiver is held in position to catch the lotion, which is allowed to run on to the conjunctiva from a height of about one inch (Fig. 93). The temperature of the lotion should be 99° F., and it should be directed from the inner corner of the eye towards the outer corner. Drops and droppers should be sterilized and the drops warmed by standing the bottle in a bowl of warm water.

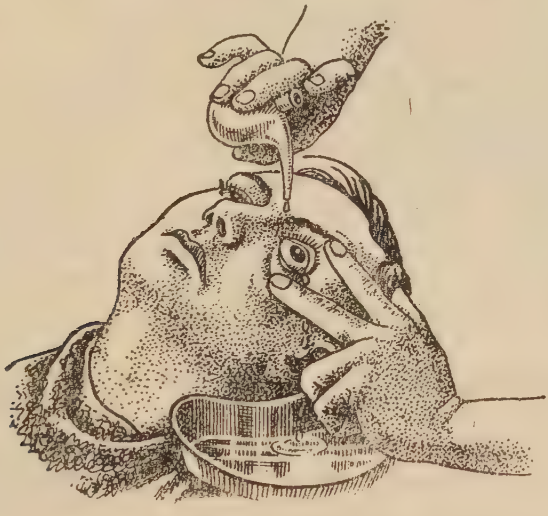

Fig. 93.—Applying Eye Lotion from an Undine.

Bathing of lids.—Where the eyelids are inflamed, as by a stye, they can be bathed by means of a padded spoon. A bowl is half filled with boiling boracic lotion, and the patient holds his eye over the steam. Then a wooden spoon padded with cotton-wool covered with lint is dipped in the lotion and held near the eye. As the patient grows accustomed to the heat, the pad can be brought into contact with the eye, and the bathing is continued for the prescribed period.

Ointment.—Use a small glass rod, rounded at the ends, and place the ointment on one end. If the conjunctiva is to be treated, stand behind the patient and draw down the lower lid. Place the rod horizontally along the eye, between the lid and the eyeball; close the lids and gently withdraw the rod outwards. If the lids are to be treated, apply the ointment in a similar way, laying the rod along them.

Cleanliness.—All drops, ointments, lotions, and swabs used in eye work must be sterilized. Undines and glass rods should be boiled before and after use. The hands must be carefully scrubbed and dried on a clean towel before touching the eyes.

Always swab the eye outwards and never use the same swab twice.

The Ear

381. Ear drops.—Drops may be used (*a*) to soften wax, (*b*) to dry the ear after syringing, (*c*) to ease pain, or (*d*) as an antiseptic. They must never be applied when there is reason to suspect recent injury of the ear-drum.

Olive oil, hydrogen peroxide, or sodium bicarbonate solution (10 grains to 1 oz.) are used for softening ; boric acid (20 grains to $1\frac{1}{2}$ oz. spirit) for drying ; and glycerin and carbolic to ease pain or as an antiseptic.

The patient's head should be laid on a pillow or table with the affected ear uppermost. The drops should be heated in a teaspoon, or in a minim-glass placed in a bowl of hot water.

Draw the ear upwards, backwards and outwards, and pour in the drops from the minim measure or a pipette. If the object is to soften wax before syringing, the drops should be inserted ten minutes beforehand and the patient should remain in the same position until syringing is carried out.

382. Syringing of ears.—The aim is to clear the external auditory canal of wax, or to wash away discharge. Great care is necessary because of the danger of injury to the delicate ear-drum, and syringing must never be undertaken without instructions from the medical officer.

An ear syringe is made of metal, with a straight nozzle and a flange for the fingers. If no ear syringe is available, a Higginson syringe, with a Eustachian catheter attached in place of the nozzle, is an excellent alternative. The ordinary nozzle of a Higginson syringe must not be used, because the force of the flow would be too great ; nor must the syringe be one that is used for any other purpose.

The requirements are a syringe, a bowl of lotion warmed to 99° F., a receiver, a mackintosh, a towel, and dry swabs. The patient should sit, or lie, so that the light falls on the ear to be syringed. Arrange the mackintosh and towel to protect his clothing, and give him the receiver to hold under his ear to catch the outflow (Fig. 94).

Fill the syringe with lotion, and expel the air. Then with the left hand draw the ear upwards, backwards and outwards to straighten the canal. Insert the nozzle carefully into the ear-hole and expel the lotion gently and evenly in a slightly

upward direction; the fluid will then flow over the surface of the drum. Repeat this several times.

If the aim is to remove wax, remember that it must be softened beforehand, as described above. Sometimes the wax is so adherent that it will not come out. If it resists the first attempt, more softening is probably needed, and the sister or medical officer should be informed. Another attempt can be made later.

FIG. 94.—SYRINGING THE EAR (THROUGH A EUSTACHIAN CATHETER ATTACHED TO A HIGGINSON SYRINGE).

When all the wax is removed, the lotion returns quite clear, and the temporary deafness of the patient is relieved. He should then tilt his head towards the receiver to let any surplus fluid escape. Use a little cotton-wool to dry the outer end of the canal. If the weather is cold and windy, it is wise to leave a loose plug of wool just inside the meatus for an hour or two.

Forceps or probes must never be introduced into the ear by inexperienced hands. Lotions for syringing include boracic lotion, and bicarbonate of soda (10 grains to 1 oz.).

After any kind of injury that may possibly have damaged the drum, the ear must NOT be syringed, even though wax or blood blocks the canal. Such cases must be referred to a medical officer.

CHAPTER 51

BATHS, PACKS AND SPONGING

383. Baths include plain water baths, medicated baths, hot-air baths and vapour baths.

A nursing orderly should ask for instructions as to the temperature of the water required, and the time the patient is to stay in the bath. He must always note the temperature of the water before he puts the patient in the bath; and no patient in a bath should be left alone unless he is quite well.

384. Plain water baths.—According to temperature, these are:—

(*a*) *Hot bath.*—Temperature 100° to 110° F.; 10 to 15 minutes. Used in renal colic to allay spasm; in retention of urine to induce passing water; and in uræmia to promote sweating. Also sometimes helpful in cholera to warm and strengthen the patient, and in delirium to soothe him.

(*b*) *Warm bath.*—T. 92° to 100° F.

(*c*) *Tepid bath.*—T. 85° to 92° F.

(*d*) *Cool bath.*—T. 70° to 85° F.

(*e*) *Cold bath.*—T. 50° to 65° F. A drastic form of treatment which calls for skilled nursing and careful observation. Rarely used during illness, but valuable in selected cases.

(*f*) *Continuous bath.*—T. 97° F. during the day and 100° F. during the night. These baths are continued for hours, days, and sometimes weeks. They are used for patients with severely infected wounds, extensive burns and some skin diseases.

A thermometer should be kept in the bath and the temperature maintained. The bath should be entirely emptied once in 12 hours; meanwhile the patient should be put in bed, and given the bedpan and urine bottle. Care is required, when adding hot water and removing the cooled water, to maintain the proper temperature. Except for a hole for the patient's head, the bath should be kept entirely covered: a strip of canvas or sheet folded lengthways, stretched across the bath to take a pillow, will be required for his head; also suitable padding for his back, and rests for the limbs involved.

385. Medicated baths.—Various remedies may be added to baths. For example :—

(*a*) *Sulphur bath.*—T. 92° to 100° F. Prepared by adding 4 oz. sulphurated potash (dissolved in boiling water) to 30 gallons of water. Used in certain skin conditions.

(*b*) *Carbolic bath.*—T. 92° to 100° F. Prepared by adding 10 oz. pure carbolic to 10 gallons of water. The pure carbolic should be mixed thoroughly in 4 pints of hot water before it is added to the bath, which is used for skin conditions and for disinfection. Great care must be taken in handling pure carbolic, which burns the skin.

(*c*) *Iodine bath.*—T. 105° to 120° F. Prepared by adding one teaspoonful weak solution of iodine to one pint of water. It is usually given as a " local " bath, that is to say, only one part of the body, such as the hand or foot, is immersed.

(*d*) *Boracic acid bath.*—T. 92° to 105° F. Take a saturated solution of boracic (boric) acid and heat to the required temperature ; or add an equal quantity of hot water to the saturated solution. Usually given as a local bath, but it may be used to allay irritation in skin conditions, when 2 to 3 lb. of boracic acid is added to 30 gallons of water.

(*e*) *Alkaline bath.*—T. 100° to 112° F. Required : 1 oz. sodium carbonate (washing soda) to every 7 gallons of hot water ; or 1 lb. sodium bicarbonate (baking soda) to every 30 gallons of hot water. Used in rheumatism.

(*f*) *Brine bath.*—T. 100° to 112° F. Prepared by adding 6 lb. common salt to an ordinary bath.

(*g*) *Mustard bath.*—T. 92° to 105° F. Prepared by mixing 1 lb. mustard to a smooth paste with warm water and adding it to a bath of 30 gallons.

(*h*) *Bran bath.*—T. 100° F. Prepared by tying up in a bag 2 to 3 lb. of bran and boiling it in a saucepan with 4 pints of water. The resulting liquid—called a mucilage—is added to the bath. Used to allay skin irritation.

386. Hot-air bath.—T. 120° F. Duration : 20–30 minutes. Object : to increase the activity of the skin.

Requirements.—The radiant heat cradle, which is a full-length cradle fitted with electric-light bulbs on different

switches so that the heat of the bath may be graduated. Also two long pieces of waterproof sheeting, three extra blankets, two towels, a bath thermometer, an ice-bag or cold wet cloth and a bucket of water or sand in case of fire.

Method.—Roll a piece of waterproof sheeting covered with a blanket under the patient, cover him temporarily with another blanket, and remove his pyjamas. Place the electric cradle over the patient, covering it with waterproof sheeting and a blanket; then add the top bedclothes, taking care to put the sheet next the quilt, and tucking in the bedclothes at the sides so as to retain all the heat. Withdraw the blanket covering the patient, and put it by the side of the fire or on the radiator with the pyjamas and one towel.

Put the bath thermometer inside the cradle so that it can easily be reached to note the temperature. Tuck the blankets well round the patient's neck and place a towel over them under his chin. Turn on the electric current. When the temperature of the bath has risen to about 100° F., apply an ice-bag or cold wet cloth to the forehead. Give the patient hot drinks while in the bath and wipe the perspiration from his face. The patient may complain of burning if sweat collects on any part of the skin exposed to the radiant heat, and it must be wiped off if necessary. Note the temperature of the bath from time to time, and never leave the ward or room, as the patient may feel faint. If he complains of exhaustion or faintness, turn off the current.

The bath is continued until the temperature has been maintained for the prescribed time. Then turn off the current. Get an assistant to hold the bedclothes at the top; then grasp the lower end of the cradle, with the waterproof sheeting covering it, and withdraw them, allowing the blankets which are hot to fall on the patient. Leave him covered in this way for about an hour; then rub him down with hot towels, put on warmed pyjamas and a hot blanket, removing the under-blanket and waterproof sheeting; replace the top bedclothes and leave the patient comfortable.

The following points should be noted: the degree of perspiration (whether slight, moderate or heavy); the quantity of urine passed during and after treatment; and the general condition. The pulse must be carefully observed throughout the treatment.

387. Vapour bath.—T. 120° to 125° F. Duration: 20 to 30 minutes. Object: to increase the activity of the skin.

This is given in the same way as the hot-air bath, except that Allen's apparatus is used. This includes a kettle with a long spout, and steam from the boiling water is introduced

into the bed instead of dry hot air. The water should be boiling when the spout of the kettle is inserted through the hole at the end of the special wicket cradle used. The kettle should not be more than two-thirds full, and it is kept boiling by means of a spirit lamp or electricity.

Packs

388. Hot dry pack.—Duration: 1 to 1½ hours. Useful if the apparatus for a hot-air bath is not available.

Requirements.—Four hot blankets, six hot-water bottles with covers, and two towels.

Method.—Open the blankets on a spare bed, or other convenient place, and lay them one on top of the other; roll them lengthways together and place them under the patient. Remove his pyjamas and put them with two towels to warm by the fire; wrap each blanket round him separately, tuck in well at the neck, and fold over the feet. Place three hot-water bottles at each side and replace the usual top bedclothes. Give plenty of hot drinks.

When sweating has ceased, open the blankets, dry the patient quickly with warm towels, put on his warmed pyjamas, leave him between two dry blankets and replace the top bedclothes.

389. Hot wet pack.—Duration: 20 minutes from the onset of sweating.

Requirements.—Four blankets and a long piece of waterproof sheeting; a large wringer with two sticks; a small bath; boiling water, and hot-water bottles.

Method.—Open the blankets and waterproof sheeting on a spare bed, or other convenient place, in this order: two blankets, waterproof sheeting, one blanket. Roll these together lengthways and place them under the patient; remove his pyjamas and put them with two towels to warm before a fire.

Fold the fourth blanket (preferably an old thin one) or a sheet lengthways, and double it into the wringer in the bath. Pour on boiling water, and, with an assistant, wring it out as dry as possible, using the sticks threaded into the wringer ends. Take it out of the wringer, shake it out and place it under the patient as hot as he can bear; fold it closely over him; then wrap separately over him all the blankets and the waterproof sheeting, which are already underneath; place several hot bottles round the pack to keep it warm, and put on the top bedclothes; give the patient plenty of hot drinks.

When ready, remove the wet blankets and waterproof sheeting, wrap the dry ones and top bedclothes round him,

and leave him for one hour. Finally dry him with hot towels, and reclothe him in pyjamas; leave one blanket over him under the top bedclothes.

390. Cold or ice pack.—Duration: 30 to 60 minutes.

Requirements.—A long piece of waterproof sheeting; three sheets (or two sheets and twelve towels): a small bath; a large wringer; cold water, ice, and a clinical thermometer.

Method.—Roll the waterproof sheeting, with one sheet over it, under the patient; strip him and leave him covered with a sheet. Soak the sheets or the towels in cold or iced water and wring them out; place them immediately over the patient, moulding them closely to each limb. If towels are used instead of a sheet, wrap the patient's limbs in the towels, using one or two for each limb and one over the chest and abdomen. As the towels get warm replace them by others which are soaking.

Ice may be rubbed over the towels on the arms and legs if it is difficult to reduce the temperature, but care must be taken lest this causes shock.

Take the patient's temperature when starting the pack, and every 10 minutes afterwards, keeping careful watch on the pulse. Have a hot blanket and hot-water bottles in readiness. When his temperature has come down to a point 2 degrees higher than that to which it is intended to fall, remove him from the pack; dry him, replace his pyjamas, and cover him with a sheet and a blanket. Take the temperature again an hour later.

If there are any signs of collapse while the patient is in the pack, remove him at once, and give him hot blankets and hot-water bottles.

391. Sponging.—This is much employed to reduce the temperature and to induce sleep. Duration: 15 to 20 minutes, or as ordered.

(*a*) *Tepid sponging.*—Start with water at 90° F., cool down to 70° F.

(*b*) *Cold sponging.*—Start with water at 70° F.; cool down to 50° F. or lower.

Requirements.—A long piece of waterproof sheeting; two blankets or bath sheets; a sponge and towels; a basin, cold water and ice; a bath thermometer and a clinical thermometer.

Method.—Roll under the patient the waterproof sheeting with one blanket or bath sheet over it; cover him with the second blanket and take off his pyjamas. Note his temperature and pulse and the temperature of the sponging water.

First sponge and dry the face, and apply a cold wet cloth to the forehead. Then sponge with long single strokes, exposing each limb, the chest, and the abdomen in turn ; cover each part again without drying. Cool the water as required with cold water or ice.

Spend the last five minutes in sponging the back. Ten minutes after completion take the temperature again, and if it is not sufficiently reduced resume sponging, provided that the patient's general condition is satisfactory.

Dry him by gentle dabbing ; remove the waterproof sheeting and blankets ; reclothe him in pyjamas, and leave him covered with one sheet, or one sheet and one blanket. If he shows signs of shock or shivering, stop sponging and give him a hot bottle and blanket.

CHAPTER 52

THE ENEMA

392. Enemas are liquid preparations injected into the rectum. They are of two kinds : (*a*) those not to be retained, and (*b*) those to be retained.

393. Method of administration.—The requirements and method differ slightly according to the purpose of the enema.

Enema not to be retained.—The articles needed will be :—

- (*a*) An enema syringe (Higginson's) with rubber catheter or rectal tube attached.
- (*b*) A small pot of soft paraffin or other lubricant ; some swabs ; a bowl or jug for mixing ; a receiver ; a thermometer ; waterproof sheeting and cloth ; a bedpan and cover.

These are shown in Fig. 95.

The patient lies on his left side with his head and shoulders in the centre of the bed, both knees drawn up, and his buttocks well over the edge. (Left lateral position). If he cannot lie in this position, he should be on his back, near the right-hand side of the bed, with both knees drawn up. (Dorsal position).

Place warm waterproof sheeting, covered with a cloth, under the buttocks ; turn back the bedclothes, except one blanket, exposing the patient as little as possible ; lubricate the end of the catheter with olive oil or soft paraffin ; remove air from the apparatus by filling it with enema fluid.

With the right hand insert the catheter gently into the anus, and slowly pass the tube from 2 to 4 inches into the rectum. Hold the catheter in position with the left hand, and with the

right hand pump slowly, evenly, and continuously, until the required quantity has been given. Too vigorous pumping causes pain to the patient, and makes him return the enema too quickly.

Remove the catheter gently, detach it, and place it in the receiver ; then, if possible, leave the patient on his side for a few minutes. A better evacuation of the bowel is usually secured if the enema is retained for a short time ; but many patients cannot keep it in. When the patient is ready for the bedpan, he is laid on his back with waterproof sheeting (covered by a cloth) beneath him ; the bedpan is placed in position, and the bedclothes adjusted. The result of the enema must be noted, and saved for inspection if necessary.

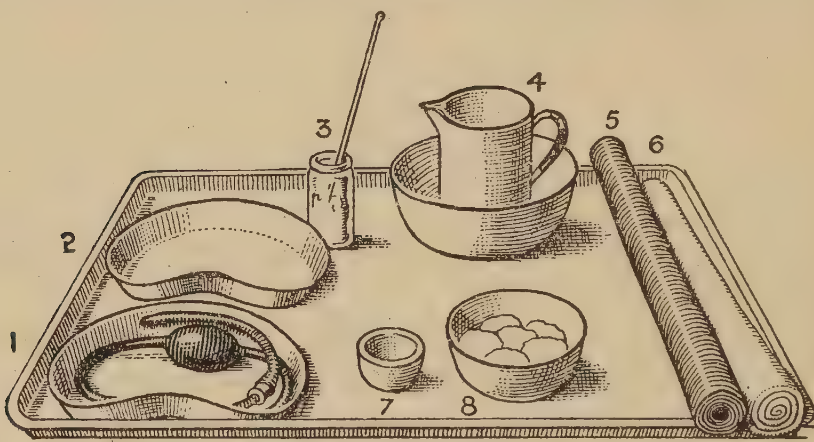

Fig. 95.—Enema, not to be Retained.

1. Higginson's syringe and rectal tube
2. Receiver
3. Thermometer
4. Measure jugs for enema
5. Mackintosh sheet
6. Draw-sheet (or cloth)
7. Lubricant
8. Swabs

Enema to be retained.—Instead of a Higginson's syringe and catheter, use a rectal tube (size 8 or 10) joined by a glass connection to a piece of rubber tubing about 2 feet long, to which is attached a glass or enamel funnel. A clip or Spencer Wells forceps is needed to regulate or stop the flow from the funnel. The jug containing the enema should be kept warm in a bowl of hot water.

With the patient and bedclothes arranged as described above, the rectal tube is lubricated, the apparatus is filled with fluid to exclude air, the rubber tube is clipped at its lower end, and the rectal tube is inserted. When it is in place, fill the funnel with the liquid, release the clip, and raise or lower the funnel to regulate the flow.

Injections should be given very slowly (10 oz. in 15 minutes); otherwise they are not retained. When the required amount has been given, apply a clip or forceps and remove the tube, gently but not too slowly. To help him retain the enema, the patient should be left comfortable and quiet and should be moved as little as possible.

394. Enemas not to be retained.—These are given to cleanse the rectum (cleansing), to produce bowel action (purgative), to reduce flatulence (antispasmodic), or to remove worms (anthelmintic).

CLEANSING ENEMAS.—The following are commonly used:—

Soap-and-water enema.—1 teaspoonful of soft soap or plain yellow soap (shredded and boiled down to a jelly) to 1 pint of warm water. Mix until lathered; remove all froth. 1 to 2 pints may be given at 100° F.

Olive oil enema.—4 to 5 oz. heated to 90° F. is given with rectal tube and funnel, retained, and followed by a soap-and-water enema half an hour to an hour later.

Glycerin enema.—2 to 8 teaspoonfuls of glycerin is injected with a small catheter attached to a glass syringe.

PURGATIVE ENEMAS should be retained as long as possible—even for 2 hours—to get the best results. They may be followed by a soap-and-water enema if necessary.

Castor oil enema.—2 oz. castor oil, mixed with 4 oz. olive oil, is given with a tube and funnel at 100° F. Or 2 oz. castor oil, mixed with 10 oz. soapy fluid or starch mucilage.

Magnesium sulphate enema.—1 to 2 oz. magnesium sulphate in 6 to 8 oz. water is given at 100° F.

Ox-bile enema.—2 to 4 oz. bile in 6 to 8 oz. water is given at 100° F.

ANTISPASMODIC ENEMAS.—After administration the amount of flatus passed should be noted.

Turpentine enema.—$\frac{1}{2}$ to 1 oz. oil of turpentine, 2 oz. olive oil, and 1 pint of soap-and-water enema are required. 5 oz. of the soap and water is mixed thoroughly with the turpentine and olive oil in a measure glass. First a funnel full of soap solution at 100° F. is run in by tube; then the turpentine mixture at the same temperature; then the rest of the soap solution.

Another method is to mix the turpentine and olive oil with a pint of soap and water; but care must be taken that the turpentine is well mixed, to prevent irritation or burning.

Molasses enema.—2 to 3 oz. molasses or black treacle is mixed with an equal amout of milk, and given at 100° F. Or 2 to 3 oz. treacle may be ordered with 15 to 20 oz. milk or water.

ANTHELMINTIC ENEMAS.—The usual varieties are :—

Salt-and-water enema.—2 to 3 teaspoonfuls of salt is given in a pint of water, by tube and funnel or enema syringe, at 100° F.

Quassia enema.—The rectum is first washed out with a soap-and-water enema. Then 10 oz. infusion of quassia (1 in 20) is run in with tube and funnel at 100° F.

395. Enemas to be retained.—These are given to relieve pain and check diarrhœa (sedative) ; to reduce shock, or stimulate after poisoning (stimulant) ; or to provide nourishment (nutrient).

SEDATIVE ENEMAS include the following :—

Starch-and-opium enema.—2 to 4 oz. thin cold starch with 20 to 30 minims of tincture of opium (as may be prescribed) is slowly run in with tube and funnel. The thin starch (or mucilage) is made by mixing 2 teaspoonfuls of powdered starch with cold water to form a smooth paste, and adding boiling water up to 1 pint.

Bromide or chloral enema.—When these drugs cannot be taken by the mouth, they may be given in enemas by tube and funnel in dosage prescribed.

Iced-water enema.—Sometimes iced water is employed as an enema in heat-stroke.

STIMULANT ENEMAS.—Saline solution is often given per rectum, and occasionally stimulants such as coffee are used.

Rectal saline.—The object is to supply the body with fluid, absorbed through the lower bowel. When fluid cannot be taken freely by mouth, rectal injection is a useful alternative to intravenous or subcutaneous injection.

10 to 20 oz. of normal saline (1 teaspoonful of salt in a pint of water), sometimes with glucose and brandy added, is run in very slowly through a rectal tube, which is connected to a special apparatus comprising a thermos flask and a Ryall's drop tube. The flask keeps the saline at 120° to 125° F. The Ryall's tube permits observation and control of the flow. When the saline reaches the rectum its temperature has fallen to about 100° F.

If the special apparatus is not available, an ordinary douche-can is connected to the rectal tube, to which a screw clip is fixed. This clip is so adjusted as to allow drop-by-drop flow. The saline in the douche-can should be at 125° to 130° F.; as it cools, more warm saline should be poured in.

Strong coffee.—4 to 6 oz. black coffee (well strained), with 1 oz. brandy, is run in slowly by tube and funnel at 105° F. Coffee may be given in this way to counteract drowsiness after poisoning.

NUTRIENT ENEMAS.—When it is inadvisable or impossible to feed a patient by other means, nutrient enemas (rectal feeding) may be ordered. The food thus given does not come into contact with the digestive juices; hence it must be capable of absorption by the bowel. Very few forms of food can be so absorbed.

1 oz. glucose dissolved in 10 oz. normal saline may be run in slowly in the same way and at the same temperature as a rectal saline. These feeds are repeated every 4 to 6 hours. In order that he may retain them, the patient should be kept quiet for half an hour or more. A soap-and-water enema should be given early each morning to those having rectal feeds.

CHAPTER 53

SURGICAL CLEANLINESS

396. Surgical cleanliness means much more than ordinary personal cleanliness. It means not only absence of dirt, but absence of germs. Absence of germs constitutes *asepsis*. The principle of aseptic treatment is that everything brought into contact with a wound has been freed from germs (or rendered *sterile*) by sterilization.

INSTRUMENTS AND EQUIPMENT *

397. Sterilization of instruments.—All instruments, except perhaps cutting instruments and needles, can suitably be sterilized by boiling in a 1 per cent. solution of bicarbonate of soda for at least 20 minutes. After this they must be handled only with sterile forceps; and if they touch anything that has not been sterilized they must be boiled again.

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* A list is given in Appendix II.

If the instruments are to be used dry, as most surgeons prefer, the inner tray of the sterilizer, with the instruments inside it, is lifted out, and placed on a table covered with sterilized waterproof sheeting and a sterilized towel. The table is then wheeled into the theatre, where the sister transfers the instruments to her instrument table, covering them with another sterilized towel. In wheeling the table into the theatre, the orderly should be careful not to touch the sterilized waterproof sheeting or towel covering the top of it. Nor must he breathe over the instruments.

Forceps.—All gripping instruments, such as Spencer Wells forceps, should be opened before they are boiled.

Cutting instruments.—Scalpels, scissors, razors, needles and other sharp instruments are usually sterilized by immersion in a tray of pure carbolic acid, Lysol or " antiseptic fluid " for at least half an hour, and preferably for several hours. They must be thoroughly cleansed before immersion and should rest on a layer of gauze or lint with all sharp edges and points carefully protected from the sides of the container.

On removal from the disinfectant they are rinsed, first in sterile saline solution and then in methylated spirit, and laid on a sterile towel.

Many surgeons prefer that all instruments except scalpels should be sterilized by 20 minutes boiling.

If required urgently, any cutting instrument can be boiled for two minutes without seriously impairing its sharpness. The edge or point should be guarded with lint ; or the instrument may be held under the surface of the boiling water by means of forceps.

Cleaning of instruments after use.—After an operation, scrub all instruments in *cold* water with a nailbrush kept only for this purpose. Take care to remove all traces of blood from the roughened jaws of the forceps.

Place the sharp cutting instruments in Lysol, and boil the rest in the sterilizer for 5 minutes. After sterilization put all the instruments in an enamel bowl containing water with a little Lysol, which helps to keep instruments polished and makes drying easier. Dry thoroughly, especially the joints. Then smear the joints of delicate instruments with liquid paraffin or glycerin to prevent rust.

Scalpels, chisels, and gouges should be re-sharpened, if possible, before they are used again.

398. Sterilization of other equipment.—Heat is always the most certain means of sterilization.

Bowls, trays, dishes and *gallipots* should be boiled before use for at least 20 minutes ; where steam pressure is available, they can be tied in a sheet and placed in the sterilizer.

Towels, gowns, caps, masks, dressings and *swabs* should be lightly packed in drums ; the light packing allows the steam to penetrate thoroughly. The drums should have well-fitting calico linings to separate the contents from the sides of the drum. The cover of the lining should be placed over the contents before the lid is closed. The drum is then placed in the high-pressure sterilizer.

It has been proved that all germs are destroyed by compressed circulating steam at 266° to 293° F. in 15 minutes. This is the most efficient means of sterilizing surgical dressings. At 212° F. articles must be sterilized for three-quarters of an hour.

After sterilizing, the drums must be sealed up, and they should not be opened until they are required by the surgeon or nurses. The articles are then lifted out with a pair of sterilized forceps ; on no account must they be touched with the hands.

When a drum of dressings has been opened, any dressings not used must be re-sterilized.

Jaconet mackintoshes should be well powdered with French chalk, folded up, and sterilized in the drum with the towels.

Rubber gloves are useless unless quite sound. To examine them for holes, fill them with water, and press lightly ; any puncture, however small, will at once be evident.

Gloves can be sterilized by two methods :—

Dry sterilization.—Dry the gloves well and powder inside and out with french chalk. Turn back the cuffs, and place a small gauze bag of chalk in one of the gloves ; this chalk will be needed when the surgeon puts them on. Arrange both gloves in a calico envelope, or wrap them in lint, so that one glove does not touch the other. Mark the size of the gloves on the outside of the packet and place it in the drum.

Wet sterilization.—First make sure that the gloves sink in the water ; then boil for 20 minutes. Lift out with sterilized forceps and place in sterile water or saline solution.

Ligatures and sutures.—Ligatures are used to tie blood-vessels Catgut ligatures are generally employed, but sometimes silk, linen or cotton thread.

Sutures are used to join the edges of a wound, either through the skin or through the tissues beneath. They are of many

kinds, including silkworm gut, catgut, horsehair, kangaroo tendon, silver wire and thread.

Silk, horsehair, linen thread, silver wire and silkworm gut are sterilized by boiling. Catgut cannot be boiled; it is usually supplied already sterilized in sealed glass tubes.

Operating Theatre and Personnel

399. The theatre.—Everyone engaged in surgical work should pay attention to aseptic details; on this largely depends the success or failure of the operation. The theatre must be clean and free from dust. Most modern theatres are built with rounded corners and polished surfaces, which reduce to a minimum the lurking-places for dust and germs. The ceiling and walls should be washed down with soap and water, windows cleaned, furniture washed, and castors cleaned once a week.

Daily routine.—The floors are scrubbed with soap and water—sweeping is never allowed—and sinks and taps are cleaned. Tables and stools are dusted with a damp cloth, and all glass surfaces polished with methylated spirit. All lights are dusted with a damp cloth, and tested to see that they are working properly. An even temperature should be maintained in the room—not less than 70° F.—and plenty of sterilized hot and cold water must always be available.

The anæsthetist's table, with everything likely to be required, should be kept always ready. Beside the actual anæsthetics, suitable restoratives and a hypodermic syringe, tested and ready for use, should be on the table in case of an emergency.

Before an operation.—The operating-table should be warmed, either by electric radiators underneath or by rubber hot-water bottles. When the patient arrives, the bottles are arranged round him. Care must be taken to avoid burning.

400. Surgical personnel.—The hands of everyone engaged in surgical work need careful attention. Nails must be kept short, neatly trimmed and clean, and tags of skin should be removed daily.

Only those who actually handle instruments "scrub up" for an operation; but everyone who enters the theatre—anæsthetist, nurses and orderlies—must wear gowns, caps and masks.

Scrubbing up.—First take off any rings; then scrub the hands and arms, up to well above the elbows, with soap and a sterile nailbrush, for at least *five minutes*, under running water. Scrub thoroughly, using plenty of soap, and attend particularly to the nails, and between the fingers. After washing, rinse

the hands in antiseptic lotion, such as biniodide of mercury 1 in 1,000, or swab them with a piece of sterile gauze soaked in methylated spirit.

Next put on the cap and mask, taking care not to touch the head or face. Wash the hands again, and dry them on a sterile towel. Then put on the gown, and finally the rubber gloves.

If, after washing, the hands accidentally come in contact with anything that has not been sterilized, they can no longer be considered clean. The whole process must then be gone through again.

CHAPTER 54

BEFORE AND AFTER OPERATION

401. Preparing the patient.—Before a serious operation the patient is usually kept in bed for a day or two on a light diet. The urine is examined, and any aperient ordered by the medical officer is given.

On the day before operation the operation area is well shaved and the patient has a hot bath with plenty of soap. The skin must be thoroughly cleaned, the nails trimmed, and the hair washed. If the patient is too ill to go to the bathroom he is washed all over in bed ; afterwards his linen is changed.

The next step is to prepare the skin round the operation area. It must be thoroughly dry ; therefore it is cleaned with spirit. A sterile towel secured with a bandage is put over it, and left for an hour or two. Then the area is painted with weak tincture of iodine or some alternative antiseptic, applied either on a sterile swab, held in forceps, or with a sprayer.

When the iodine is dry a sterile dressing is put on, held in position by a sterile towel or bandage. The dressing must not slip ; if it does, the patient has to be prepared again. Shortly before the operation another coating of iodine is applied, and a new sterile dressing is put on.

For emergency operations, when time is of importance, the skin is dry-shaved, and the iodine applied without any preliminary washing.

The attendant who prepares the patient's skin must sterilize his hands and wear gloves, and the operation area must be protected from bedclothes by means of sterile towels.

On the instructions of the medical officer an aperient may be given on the afternoon of the day before operation. If it does not act, an enema may be ordered.

The stomach should contain no solid food at operation, and the last meal is usually taken at least four hours beforehand, often consisting of a cup of tea and a slice of toast.

Dentures are removed, teeth are carefully cleaned, and the mouth is well rinsed with a mouthwash. A specimen of urine should be kept. The patient is dressed in a long flannel gown, opening at the back, and long woollen stockings reaching well up the thighs.

The Patient after Operation

402. The first 24 hours.—As soon as the patient has been taken to the theatre, the bed should be prepared for his return (Fig. 96). It should be made up with clean linen, with a draw-sheet and waterproof sheeting placed in position, and with the bedclothes folded over to one side, so that he can be put quickly back to bed. The pillows are removed, and a towel is placed across the top of the bed to protect the sheet in case

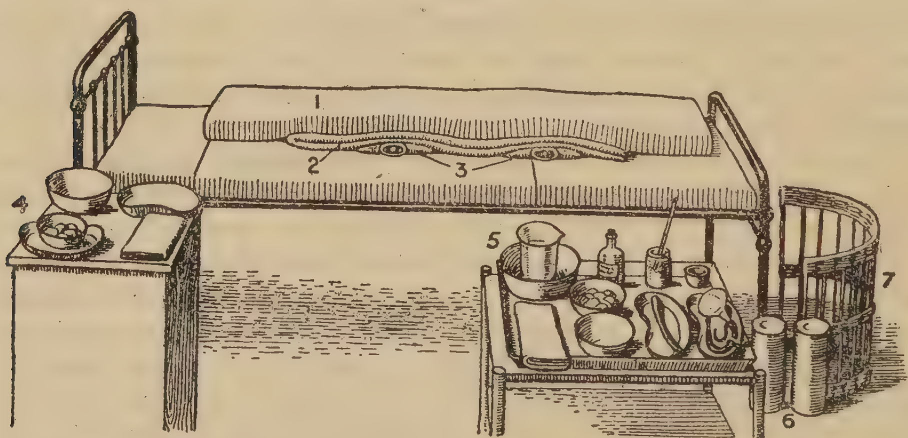

Fig. 96.—Bed Prepared for Patient Returning from Operation.

1. Bedclothes folded back
2. Warm blankets
3. Hot bottles
4. Vomit bowl, swabs and receiver; sponge-holder and tongue forceps; towel
5. Rectal saline
6. Shock blocks
7. Bed cradle
8. Mouth-gag.

of vomiting. Hot bottles, protected by flannel covers and a blanket, warmed near the fire, are placed in the bed.

As the patient may vomit before he has fully recovered from the anæsthetic, a towel, receiver, tongue forceps, and mouth-gag should be at hand.

After any severe operation, he will suffer more or less seriously from shock. Wooden blocks should be ready for raising the end of the bed, and preparations may have to be

made for transfusion of blood or plasma or for injecting other fluids into a vein. Over-heating of a shocked patient by hot bottles is to be avoided, and the bottles should be placed *outside* the blankets so that there is no risk of burning. The pulse must be watched.

While still under the influence of the anæsthetic, the patient must never be left alone.

Normally the head is kept low and turned well to one side if there is a tendency to vomit. But when spinal anæsthesia has been used, special instructions about the position of the patient may be given, and these must be carefully obeyed or serious results may follow.

Take care that the patient does not displace the dressing as he recovers consciousness. A bed cradle should be ready to hand : it usually eases the patient by taking the weight of the bedclothes ; and sometimes it is a necessity.

The dressing must not be disturbed or even touched for the first 24 hours ; but it should be looked at from time to time. If blood or discharge is coming through, apply a fresh pad of sterilized wool on top of the dressing, and secure it with a bandage ; then inform the sister or senior N.C.O.

On the evening of the operation the night-clothes should be changed, the hands and face sponged, and the draw-sheet drawn through. The next morning—and every morning—a specimen of urine should be taken.

Food and fluid.—No food is given until all effects of the anæsthetic have passed off. Thirst may be relieved by sips of hot water, taken slowly, and, when much blood has been lost, rectal or intravenous injections of saline solution are often ordered. Weak tea and diluted milk may be allowed on the first day ; but after abdominal operations the patient has nothing but sips of water for 24 hours, and seldom any solid food until the bowels have acted after an aperient or enema.

403. Abdominal operations.—If the operation has been long and difficult, the patient may suffer severely from shock ; he must then be put to bed as quickly and carefully as possible, with his head low, and made comfortably warm. A pint of normal saline solution at 100° F., with ½ oz. brandy and 1 oz. glucose added, is sometimes given by rectum as soon as he is back in bed.

A bolster should be placed under the knees to prevent strain on the abdominal muscles and a cradle may be required to keep off the weight of the bedclothes.

Fowler's position (Fig. 75, page 220) is often used ; it diminishes flatulence, often troublesome after abdominal operations, and in septic cases it limits the spread of pus.

Ten points to watch are :—

(*a*) Abdominal distension : report it at once.
(*b*) Urine : note whether it is passed.
(*c*) Flatus : note whether it is passed.
(*d*) Vomiting and retching : if retching is severe, support the wound with a hand laid over the bandage.
(*e*) Dressings : see that they stay in place ; watch for blood or discharge soaking through.
(*f*) Temperature : keep a 4-hourly chart.
(*g*) Pulse : enter on temperature chart.
(*h*) Sleep : note quality and amount.
(*i*) Diet : carry out special instructions given.
(*j*) Mouth hygiene : use mouth-wash often.

Diet.—A diet chart should be kept. The usual plan for the first 24 hours is to give rectal salines 4-hourly or 6-hourly, and frequent sips of sterile water. Then feeds of albumin water, tea, weak chicken broth, or beef-tea are given in gradually increasing amounts. Milk should not be given, unless peptonized, and even then sparingly. On the third morning an aperient or enema is usually administered. After this has acted, some solid food may be allowed.

Retention of urine is common during the first two days. If no urine has been passed in 12 hours, let the patient hear the sound of running water, and put large fomentations over the bladder. If these measures are ineffective, report to the medical officer and prepare for the catheter.

404. Amputations.—When the patient is back in bed after amputation of an arm or leg, the stump may be placed on a small pillow on a splint, and secured with a bandage. This helps to restrain the painful muscular twitchings which sometimes occur and which interfere with rest. The dressed stump should be left exposed, so that any hæmorrhage from it can be detected at once. A tourniquet should be at hand to deal rapidly with any severe bleeding. Take great care in moving the patient and in making the bed.

405. Tracheotomy.—This is usually an emergency operation. An opening is made into the trachea, and a tube, through which the patient breathes, is inserted into the opening. The *tracheotomy tube*, usually made of silver, is formed of an outer tube and an inner tube which fits inside it. The end of the *outer tube* carries a shield with two holes ; two pieces of tape are passed through these holes and tied round the neck to hold the tube in place. The *inner tube* is movable ; it is regularly taken out and cleaned, for it may easily become clogged with deposits of mucus and membrane, thus blocking the air supply.

At first the inner tube should be taken out every two hours. This is done by gently holding the outer tube in place with the forefinger and thumb of the left hand; on no account must the outer tube be moved. The inner tube is then cleaned with a warm solution of sodium bicarbonate, which quickly removes sticky mucus; feathers, sterilized by boiling for ten minutes, are also useful.

The *dressing* is usually a bib-shaped piece of gauze, fitting round the tube; and a single layer of gauze, wrung out of hot water, laid lightly over the opening. Both dressings must be frequently renewed. Mucus should be wiped off at once with small gauze swabs, taken away and burnt.

The *air* which the patient breathes must be kept warm and moist; sometimes a steam tent is ordered. The temperature of the ward should be about 70° F. *Food* must be given at frequent and regular intervals; in severe cases, feeding by nasal tube may be necessary. Milk thickened with arrowroot or cornflour is easy to swallow.

Tracheotomy patients must never be left alone. A spare inner tube, dilators, pilot scissors and dissecting forceps should be kept in an antiseptic solution by the bedside, in case the surgeon wishes to change the tube.

406. Piles.—After operation there may be considerable pain; but this is lessened by close attention to surgical cleanliness.

Any bleeding must be reported at once. Unless there is a tube in the rectum, external bleeding is rare; but the patient must be watched for signs of internal bleeding.

The bowels are usually kept confined for three days. Then an aperient is given, and 3 or 4 oz. olive oil introduced into the bowel with a soft catheter and funnel. Some surgeons prefer an enema (6 oz. olive oil and 14 oz. thin gruel) to an aperient. The patient is kept in bed until the stitches have separated, except that he may be allowed to use the night commode.

Nowadays piles are often treated by injection. This form of treatment demands less preparation of the patient and reduces the time in bed after operation.

407. Hernia.—The radical cure of inguinal hernia (rupture) is one of the commonest operations in the Army. Points to observe are these:—

(*a*) Take care that the dressing is not soiled with urine when the bottle is used. It is a good plan to pin over the dressing a piece of jaconet with a hole for the penis.

(*b*) The patient will have to be washed and looked after as a helpless patient at first. But special exercises, which play an important part in his restoration to fitness, will begin if possible while he is still in bed.

(*c*) When the patient gets up, a pad of cotton-wool, held in place by a spica, is worn for 7–10 days. Afterwards no support is needed.

408. Mouth and jaw operations.—Special attention is needed to ensure (*a*) that the tongue does not fall back, and (*b*) that hæmorrhage has not recurred.

A tongue forceps should be kept at hand. If a ligature has been passed through the tongue as a means of control, it must not be removed without an order from the medical or dental officer. Much of the success of the later treatment depends on careful and thorough cleansing of the mouth with a warm non-irritating lotion delivered through a Higginson's syringe.

409. Secondary hæmorrhage.—This must be watched for after all major operations, especially amputations. It may occur at any time from the second day to the end of the second week after operation. The cause may be (*a*) slipping of a ligature, or (*b*) sepsis, which breaks down blood clot or opens up a blood-vessel.

Any hæmorrhage, however slight, should be reported at once. If it is profuse, prompt action must be taken to cope with the emergency until the arrival of the surgeon.

CHAPTER 55

NURSING OF MEDICAL CASES

410. Some knowledge of the commoner diseases, and the kind of care they need, will help the nursing orderly to co-operate intelligently with the medical officer.

Diseases of the Heart and Blood-Vessels

411. Heart failure.—The commonest cause of death in medical cases is failure of the heart. When the heart muscle begins to flag, the patient may complain of :—

Shortness of breath.
Faintness or giddiness.

Signs of failure are :—

A quick, feeble, irregular or thready pulse.

Rapid breathing, with either pallor or cyanosis.

Swelling of feet and ankles caused by fluid accumulating under the skin (*œdema*). Later there may also be fluid in the abdominal cavity.

Pain and tenderness over the liver, which is often enlarged.

Restlessness.

The heart may fail quite suddenly, or it may gradually become unequal to its task. Rapid failure is seen when the supply of blood to part of the heart muscle is cut off, as in coronary thrombosis (para. 413), or when the muscle is poisoned by germs, as in pneumonia and diphtheria. Slow failure (over a period of years) develops when the valves have suffered serious damage, as in rheumatic fever. Damage of the valves makes the heart inefficient as a pump, and it has to work harder to keep the same amount of blood in circulation.

Some degree of weakness of the heart muscle is seen in many acute medical cases ; but most patients regain their strength when the illness has run its course. Rest—sometimes absolute rest—is essential for a tired or damaged heart ; and good nursing helps to provide it.

412. Diseases of the heart.—Infections may attack the lining membrane of the heart (endocarditis), or the membrane covering its outer surface (pericarditis), or the muscle itself (myocarditis).

Endocarditis.—When the lining membrane becomes inflamed, as sometimes happens in young people with acute rheumatism (rheumatic fever), the valves are often affected. The result may be scarring or shrinking which either narrows the openings between the valves (stenosis) or prevents the valves from closing properly. Either the blood cannot pass the valves as easily as usual, or else some of it comes back at each contraction (regurgitation). " Murmurs " heard by the doctor when he listens with his stethoscope tell him whether there is stenosis or regurgitation, and which valve is at fault. It may be either the mitral or the aortic valve, or both. (*See* Fig. 17, page 35).

Pericarditis.—The heart is partially surrounded by a cavity (the pericardial cavity) lined by a membrane called the *pericardium.* Inflammation of this membrane may be dry, or it may produce fluid (*effusion*) in the cavity.

Myocarditis.—Whenever a patient is seriously ill with fever, there is a certain amount of inflammation or poisoning of the heart muscle or *myocardium.* The poison or toxin produced

by the diphtheria bacillus, for instance, can weaken the muscle so much that the patient may die suddenly through some slight exertion such as sitting up in bed. This is one of the reasons for rest during illness, and sometimes during convalescence too.

413. Diseases of the blood-vessels.—Many diseases lead to damage of the blood-vessels. For example, chronic kidney disease (nephritis), syphilis, and long-continued poisoning by lead or alcohol may cause degenerative changes which thicken the walls of the arteries. This condition (arteriosclerosis) may also arise without any apparent cause, and it is often associated with an abnormally high blood-pressure. This in turn may slowly affect the efficiency of important organs, and whenever the arteries are weakened by disease there is risk of cerebral hæmorrhage (described in para. 191).

Degenerative changes in the coronary arteries, which carry blood through the heart, are particularly serious. When these arteries are narrowed, the flow of blood through them is easily stopped by contraction of the muscle in their walls, or by a small clot which lodges in the artery and blocks the passage. If for either of these reasons the flow of blood ceases, part of the heart—perhaps a large part—is temporarily or permanently deprived of oxygen. This is a common cause of heart symptoms in people over 45 years of age, and, though the first attack is occasionally fatal, the trouble may return at intervals for many years. The principal symptom is a gripping pain behind the sternum, often extending down the left arm. It may be due to :—

True *angina pectoris*, in which physical effort or mental excitement causes contraction (spasm) of muscle in the wall of diseased coronary arteries. Here the pain should soon disappear with rest.

Coronary thrombosis, in which the artery is blocked by a clot, and the pain may persist for hours or days, sometimes with fever.

Treatment of these two conditions may be essentially different, and drugs should not be given except on a medical officer's instructions.

414. General treatment for heart conditions.—The patient needs very careful nursing. He is often distressed and irritable and wants reassurance and humouring. Everything should be done to spare the heart.

He should be nursed in the position he finds most comfortable. If breathing is difficult, it will be best for him to sit on an air-ring, with his back well supported by pillows.

Patients with advanced heart failure often get relief by leaning forward on a bed-table covered with a soft pillow.

Every effort must be made to prevent bedsores; but the patient should be disturbed as little as possible; so washing, care of the back, use of the bedpan and making of the bed should all be arranged for the same time. The bed-table and locker, with all the things he is likely to need, should be within easy reach.

When complete rest is ordered, the patient must not be permitted to do anything for himself and all his wants must be anticipated. He must be washed and fed, lifted carefully on and off the bedpan, and lifted whenever his position in bed has to be changed. All sudden movement is to be guarded against. He must not even be allowed to reach for a feeding-cup or sputum mug from his locker; they should be handed to him and held for him. The slightest worry or excitement must be avoided.

Constipation has to be prevented because straining at stool puts an unnecessary strain on the heart. It is usual to order aperients which produce regular watery motions and thus relieve the strain on the kidneys by helping to get rid of fluids. All urine passed should be measured, and a chart should be kept showing the output, which often increases as the patient's condition improves.

Diet must be light and easily digested and the amount of fluid limited. Feeds should be regular and frequent; the amount given at each feed should be small, and they should contain nothing likely to cause flatulence. Chicken broth, fish, chicken, milk puddings, custard, junket, fruit, toast, rusks, biscuits and bread and butter are generally suitable; red meat and strong soups are not. A little alcohol is often helpful.

Medicines may be ordered to tone up the heart (cardiac stimulants); to help the patient to rest and sleep (hypnotics); to increase the flow of urine (diuretics); or to promote action of the bowels (laxatives or aperients). In each case the action of the medicine must be reported.

The patient must be kept under constant observation. His colour, which is often a guide to his condition, should be carefully noted. The temperature, pulse-rate and respirations are recorded twice daily or four-hourly, as ordered by the medical officer. It is important to observe the quality of the pulse—its regularity, volume and compressibility.

The respiration rate is usually increased, and in advanced cases Cheyne-Stokes breathing may be present. In this condition the respirations increase in depth, then diminish until they cease for a short time, and then begin again.

415. Rheumatic fever.—Acute rheumatism, as it is called nowadays, is serious because it often causes inflammation of the heart muscle or lining membranes, sometimes leaving the valves permanently distorted. It is a disease chiefly of children and young adults. In some cases the illness is so slight that it goes unrecognised ; in others there is inflammation and swelling of several joints, with intense pain and high temperature. Sweating is often profuse.

During the attacks—there may be more than one—the heart must have all possible rest. The patient usually lies flat with one pillow, and he should be nursed between blankets to avoid chill. A water-bed or water-pillow will help to prevent bedsores. After heavy perspiration the patient must be sponged down, dried with a warm towel, and put into a dry warm shirt. Painful joints are covered with cotton-wool retained by light bandages, and are protected by a cradle from the pressure of the bedclothes. It may be necessary to make heel-pads to keep pressure from the heels, and the feet must be supported against a pillow or bolster to prevent "foot-drop."

With a high temperature the mouth becomes dry, and sordes often form. The care of the mouth is described in para. 312. The patient's position should be changed from time to time to reduce the risk of congestion and inflammation of the lungs (hypostatic pneumonia).

Patients with acute rheumatism may have to be kept in bed for several months. It is wise to explain to them that, although they may feel better, getting up too soon would probably bring a relapse.

Diseases of the Upper Air-Passages

416. The common cold.—Inflammation of the lining of the nose and naso-pharynx increases nasal secretion, which at first is profuse and watery. This inflammation usually marks the beginning of a cold ; but it also appears, together with inflammation of the conjunctiva, in the early phase of measles before the rash comes out. If the temperature is raised, the patient is usually sent to bed. Inhalations of friar's balsam (1 teaspoonful to a pint of boiling water) may give relief (para. 379).

417. Tonsillitis.—Inflammation of the tonsils may be due to infection by various kinds of germs. If there are any whitish or yellowish patches on the tonsils the medical officer has to consider the possibility of *diphtheria*. Therefore he isolates the patient and sends a throat-swab for bacteriological examination. Tonsillitis with a rash may suggest *scarlet fever*.

In a sharp attack of tonsillitis the temperature is raised, swallowing is difficult, and the glands of the neck may be enlarged and painful. The patient should be isolated, and his eating and drinking utensils should be marked and kept separate from others. Often a throat-swab is taken for examination, and no antiseptic gargle or throat paint should be used until the medical officer has decided whether a swab is required. As in most other fevers, the patient should drink plenty of fluid, especially if he is having a sulphonamide drug. When the cervical glands are painful a kaolin poultice (para. 368) often gives relief.

418. Quinsy.—This is a painful abscess at the back of the tonsil which may make swallowing almost impossible. Hot gargles may be given every hour to induce the abscess to burst; or the medical officer may have to incise it with the point of a scalpel.

419. Laryngitis.—Inflammation of the vocal cords and the lining of the larynx is known as laryngitis. It causes hoarseness and loss of voice. Inhalations of friar's balsam or menthol are commonly ordered, and the patient should be kept in a warm even temperature.

Other Respiratory Diseases

420. In nursing patients with bronchitis and pneumonia, the orderly must always watch for, and try to prevent, heart failure. The heart muscle often has to pump more quickly than usual to overcome increased resistance to the flow of blood through the lungs. Also the supply of oxygen from the lungs to the heart (and the rest of the body) may be defective; and the heart muscle may be weakened by toxins brought by the blood-stream from infected lungs.

421. Bronchitis.—In this condition the mucous membrane lining the bronchial tubes is inflamed. The signs are cough, wheezing and shortness of breath. The patient should be kept in bed, and the air he breathes should be moist and warm. If a steam-kettle is ordered, a screen is placed round the head of the bed, with a sheet draped over it to keep in the steam. A steam-kettle with a long spout is used. First it is filled with boiling water with 1 oz. friar's balsam added; it is then kept boiling on a stove or spirit-lamp by the bedside, while a jet of steam is directed to one side of the patient's head. If a lamp or stove is used, it should stand on a tin tray, and a bucket of sand should be at hand in case of fire. The kettle should be filled, and the lamp tended, every four hours.

Bronchitis is sometimes followed by *bronchopneumonia*, when the lung becomes inflamed and partly solid round the smaller air-tubes or bronchioles.

422. Asthma.—This condition is due to spasmodic narrowing (constriction) of the small bronchial tubes. Attacks are often brought on by eating or inhaling some substance to which the patient has become sensitive, or by some strain on the emotions, such as anxiety. During the attack breathing becomes very difficult and wheezing ; there is a cough, and the face is cyanosed and dusky. The pulse may be rapid and weak if the heart is embarrassed. The patient is most comfortable sitting up in bed supported by pillows. The medical officer may give an injection of adrenaline, which usually cuts short the attack, or ephedrine.

Asthma is distressing and often terrifying to the patient, and he should not be left alone during a severe attack.

423. Pneumonia.—Bronchopneumonia, as already explained, is an inflammation of the lung tissues round the small air-tubes. In bad cases the inflamed areas may be big enough and numerous enough to join one another, so that large parts of the lung become more or less solid ; but at first there are many small patches.

In *lobar pneumonia*, on the other hand, a fairly large area—often a whole lobe or several lobes—is affected from the start. All the air cavities in this area fill with thick exudate ; and the infected part of the lung becomes solid and temporarily useless.

The patient usually appears acutely ill, with fever and quick shallow breathing. He may show cyanosis, with cough and expectoration of rust-coloured sputum. He complains of pain in the affected side of the chest and he may be restless and unable to sleep.

He is nursed in a room with plenty of fresh air ; the bed clothing should be light and warm, and an open-backed flannel shirt should be worn. The temperature and pulse are taken 4-hourly when the patient is awake, and he should be sponged down night and morning—or more often if he sweats much. Movement must be limited as far as possible. He should be given a rubber air-ring or water-pillow ; he should sit up supported by pillows, and a knee-pillow should be put in place to prevent him slipping down in bed. Oxygen, or a mixture of oxygen and carbon dioxide, may be ordered to be given for a few minutes every hour with a B.L.B. mask. Formerly oxygen was used only as a last resort ; so, if the patient is anxious, he must be made to understand that it is now part of the ordinary treatment. A kaolin poultice is often applied to the affected side of the chest (para. 368).

The use of sulphonamide drugs has revolutionized the treatment of pneumonia, shortening the acute stage of the illness and reducing the risk of death. The doctor's instructions as to the administration of these drugs must be carefully followed, and plenty of fluid—preferably glucose fruit drinks—should be provided. Unless a good flow of urine is maintained by a large intake of fluid, the kidneys may be damaged by crystals forming in the urinary passages. Cyanosis, nausea and vomiting should be noted and reported, but are not necessarily sufficient reason for discontinuing drug treatment.

The duration of lobar pneumonia, unless complications arise, is short; the acute stage is usually over within 10 days. Good nursing will do much to tide the patient over this difficult period.

424. Pleurisy.—Pleurisy is inflammation of the membrane lining the *pleural cavity*, which lies between the lung and the chest wall. Often it is an accompaniment of pneumonia: when the lung is infected and inflamed, the pleura covering it may be affected similarly. But sometimes this condition arises by itself. When no cause is obvious, the possibility of tuberculosis has to be kept in mind.

In "dry" pleurisy the chief symptom is pain on taking a deep breath. In "pleurisy with effusion" fluid is poured out into the pleural cavity, sometimes hampering the action of the heart and pushing it a little to one side. This fluid may be slowly absorbed, but often a hollow needle has to be inserted through the chest wall, between the ribs, so as to let it out (aspiration of the chest).

425. Empyema.—If a pleural effusion is infected with pus-forming germs, the condition at once becomes more dangerous and an operation may be necessary. A piece of rib may have to be removed so that thick fluid can drain freely.

426. Abscess of lung.—Sometimes lobar pneumonia and bronchopneumonia do not subside in a normal way, and fever may continue for several weeks. Either the disease slowly clears up and the patient gradually gets well, or an abscess may form in the lung tissue. This may open into a bronchus and cure itself by being coughed up. Pulmonary abscess should not be confused with empyema, which is pus in the pleural cavity, not in the lung itself.

427. Pulmonary tuberculosis.—This disease is due to the multiplication of the tubercle bacillus in the lungs. It is

important to recognize it early, so that treatment can begin before the lungs are seriously damaged. Cough, lassitude, a slight evening rise of temperature, loss of weight, and occasionally sweating and indigestion are some of the earliest indications of the disease, and the patient may cough up sputum containing blood (hæmoptysis).

X-rays usually show abnormal shadows in the lungs, and tubercle bacilli may be found in the sputum. When sputum is wanted for examination, the patient is told to cough into a sterile flask or test-tube, which is at once sealed and sent to the laboratory. Repeated examinations, on several days, are often needed.

It must be borne in mind that the breath, saliva and sputum of the patient are infectious and a possible source of danger to others. Like the common cold, influenza, measles and many other diseases, tuberculosis may be conveyed from one person to another by droplets—*i.e.*, the fine spray of saliva which is projected several feet when a person is talking, laughing, sneezing or coughing. Dried sputum is also dangerous, for the tubercle bacillus may live in dust for some time.

All utensils are marked and kept separate. A sputum mug, in which a little antiseptic has been placed, is provided for the patient's use. It is emptied, washed and boiled twice a day. A washable overall is worn when attending to the patient; this should afterwards be removed and the hands and forearms thoroughly washed.

The patient is kept in bed on a balcony or in a room with wide-open windows. If he sweats much at night he should be rubbed down with a warmed towel and his nightshirt or pyjamas should be changed. A careful record of temperature, pulse and respirations must be kept, and if "complete rest" is ordered the patient must be fed and allowed to do nothing for himself. Should hæmoptysis occur, the medical officer must at once be informed. The patient is reassured and kept as quiet and still as possible.

428. Influenza.—The name influenza is loosely applied to many kinds of minor illness in which there is fever and perhaps a sore throat and aches and pains. True influenza is seen chiefly in epidemics, and occasionally (as in 1918–19) these affect whole continents, leading to immense loss of life. The onset is sudden, with fever and usually pains in the limbs and back. The attack may not last more than a few days, but in serious outbreaks the patients often develop bronchopneumonia with severe toxæmia—which sometimes kills them within a few hours—or there may be dangerous heart weakness caused by the influenza germ (*virus*) itself.

Disease of the Urinary Tract

429. Cystitis.—In this condition the membrane lining the bladder in inflamed, giving rise to frequency of micturition accompanied by scalding pain when the water is passed. There may also be blood in the urine (*hæmaturia*).

The patient is usually instructed to drink copiously, and a bland fluid such as barley-water should be provided for him in a covered jug, refilled whenever necessary. A covered urinal, emptied frequently and removed at meal-times, should be kept at hand. A daily specimen of urine is collected in the early morning, and placed ready for the medical officer's inspection.

Drugs such as the sulphonamides may be given to combat the infection; others are useful to make the urine acid or alkaline. Some germs flourish in an acid medium, others in an alkaline; and the object is to make the environment as uncongenial as possible to the invading germ, whose nature is determined by examination in the laboratory.

430. Pyelitis.—Here the infection attacks the pelvis of the kidney, a funnel in which the urine collects for passage down the ureter to the bladder. A rigor (para. 340) may be the first symptom. Treatment is similar to that of cystitis.

431. Nephritis.—This is an inflammation which reduces the efficiency of the kidney as a filter for the blood. Albumen and blood may appear in the urine, and there may be pain over the kidney and a rise of temperature. If the kidney cannot get rid of fluids in the usual way, they remain in the body and cause œdema of the face, hands and feet.

A patient with acute nephritis is placed between blankets and clothed in a flannel shirt or bed-jacket. He is put on a special diet, and the intake of salt and fluids is restricted if there is much œdema.

Chronic nephritis may persist for years, often leading to a rise of blood-pressure.

432. Uræmia.—When a diseased or damaged kidney can no longer remove urea and other waste-products, these substances accumulate in the blood until they poison the whole system. This condition is called uræmia. The waste-products in the blood eventually irritate and poison the brain, causing either convulsions or a gradual loss of consciousness, deepening into coma. Other effects are diarrhœa, vomiting and breathlessness.

When uræmia threatens, hot bottles, hot baths or hot packs are used to induce sweating, so that the skin may get rid of as much fluid as possible, thus relieving the kidney.

Diseases of the Digestive System

433. Gastro-enteritis.—This is an acute inflammation or irritation of the stomach and intestines, causing vomiting, diarrhœa and colicky pain. It is usually due to taking infected food or drink (food-poisoning). All stools should be carefully examined for blood and mucus, and their frequency, consistence and appearance should be noted.

The patient is put to bed, and warmth is applied to the belly by a well-covered rubber hot bottle. While vomiting persists, nothing is given by mouth except small quantities of water, albumin water, or normal saline. If the patient has lost much fluid, the medical officer may inject saline and glucose solutions intravenously. Attention should be paid to the mouth and to pressure points on the back: when diarrhœa is severe, the skin may need protection with ointment. The diet is slowly increased; fruit and green vegetables, which might irritate the inflamed areas, are excluded.

Food-poisoning germs are very easily conveyed from one person to another, and anyone in attendance on a case of gastro-enteritis must be particularly scrupulous about washing before he touches anything to do with food or drink.

434. Dysentery.—The characteristic features of dysentery are blood and mucus in the stools. The bowel inflammation may be due either to a dysentery bacillus (*bacillary dysentery*) or to a parasite called an amœba (*amœbic dysentery*). Amœbic dysentery sometimes leads to abscess of the liver.

The illness requires the same kind of nursing as enteritis. The case is isolated if possible, and great care is taken not to let the infection spread—either to other patients or among the orderlies and nurses. Bacillary dysentery responds to treatment with sulphonamide drugs.

435. Typhoid fever.—This infection is spread through food and water. The germs (*Bacterium typhosum*) settle down in the lining of the small intestine, where patches of inflammation and ulceration soon appear. But they also find their way into the blood; and the disease is by no means confined to the digestive tract. Two allied germs (*Bact. paratyphosum* A and B) cause paratyphoid fever, which is similar but generally milder. The T.A.B. vaccine given to army personnel raises the body's defences against all three forms of *enteric fever*—typhoid (T) and paratyphoid (A and B).

Isolation of typhoid patients is convenient, but they can safely be nursed in a general medical ward if the rules for bed

isolation and disinfection (as described in the next chapter) are clearly understood and faithfully followed.

The illness lasts for several weeks and may prove a severe test of nursing skill. "Absolute rest" in the recumbent or semi-recumbent position is needed: the patient must not exert himself in any way and must be gently turned from side to side at intervals to prevent bed-sores. Special care must be taken to keep the mouth clean, and frequent sips of water or lemon-water will be needed to relieve thirst. High fever is usually treated by tepid sponging. Aperients and enemas must not be given unless specially ordered. The diet will be prescribed by the medical officer, but will usually include feeds of warm or cold milk (sometimes diluted) flavoured with coffee or tea, and lemon drinks with glucose. In the absence of instructions, nothing but fluid should be given, with not more than 3 pints of milk daily.

Typhoid is a disease in which observation of the patient is particularly important. The temperature, pulse and respirations will of course be recorded regularly, but watch must always be kept for "complications"—notably *hæmorrhage* into the bowel, or *perforation* of the wall of the bowel allowing escape of intestinal contents. Hæmorrhage will produce the usual signs of internal bleeding (para. 138). Perforation ordinarily causes pain, collapse and protective stiffening of the abdominal muscles. Both are due to ulceration of the intestine. If they are suspected, the medical officer must be summoned.

436. Peptic ulcer.—Ulcers of the stomach and duodenum are grouped together as *peptic ulcer*. Usually the patient has had indigestion for a long time. Diagnosis is made on the history of the illness and symptoms, assisted by X-ray examination and by examination of gastric juice removed from the stomach through a tube.

Ulcer patients are nursed in bed, and a special diet, with food at short intervals, is ordered. Smoking is usually forbidden or strictly curtailed. An alkaline powder is often given between feeds, and olive oil and belladonna mixture may also be prescribed to reduce the acidity of the gastric juice and to relieve spasm in the stomach muscles.

A patient with a peptic ulcer is often anxious about himself, and it is well to explain to him that the diet is given to rest and soothe his digestive system. On no account should visitors be allowed to bring in forbidden foods. If several patients are on special diet, it may be a good plan to place them side by side; they will enjoy comparing notes with neighbours in the same plight.

Complications that may arise are :—

Hæmatemesis (vomiting of blood).—A gastric ulcer may cause bleeding by eating away the wall of a blood-vessel supplying the stomach. The blood vomited may be bright red ; or, if it has been lying in the stomach, it may resemble coffee-grounds. The medical officer should be informed at once, and the patient should be placed flat in bed, reassured, and kept quiet. If he is much collapsed, the foot of the bed should be raised. His pulse should be watched ; a quickening pulse-rate may indicate further hæmorrhage. Nothing must be given by mouth unless ordered by the medical officer. An injection of morphine is usually ordered. It may be necessary to inject saline solution or blood or plasma by intravenous drip.

Melæna.—Dark stools (tarry in appearance because of the presence of altered blood) are a sign of bleeding. If such stools are observed the patient should be kept at rest in bed.

Perforation.—An ulcer may eat its way through the wall of the stomach or duodenum, making a hole through which their contents pass into the abdominal cavity. The patient is collapsed and complains of intense abdominal pain. The muscles of the upper abdomen are usually held rigid. The skin is pale, cold and clammy, the pulse may be weak and rapid and the temperature subnormal.

The medical officer should be informed at once. Pending his arrival, nothing is given by mouth. The patient usually receives an injection of morphine and is taken to the operating-theatre as soon as possible.

Septicæmia and Meningitis

437. Septicæmia.—This term can be applied to any disease in which germs dwell and multiply in the blood-stream. This may happen in the course of many different infections—for example, pneumonia and typhoid—and it is the cause of some of the symptoms and complications that may develop.

Thus a variety of germs—the pneumococcus, the typhoid bacillus, the meningococcus—may be responsible, and we can speak of a pneumococcal, a typhoid, or a meningococcal septicæmia. In cerebrospinal fever the illness may be at first a meningococcal septicæmia and later a meningococcal meningitis.

But the commonest cause of septicæmia, described as such, is a streptococcus or staphylococcus (both pus-forming organisms) which has entered the blood-stream through the skin. From any captured bridgehead on the surface of the body—such as an infected wound, or a boil, or even an inflamed tonsil—the germs may throw their forward troops into the blood-vessels, and occasionally they are able to overcome the body's defences sufficiently to establish themselves in the blood. This is one of the principal dangers whenever a wound is seriously infected, and the surgical cleansing and drainage of such wounds is generally necessary both for preventing septicæmia and in treating it.

The sulphonamide drugs and other new remedies will often stop germs from multiplying in the blood ; but the cure of these patients, who may be ill for weeks, largely depends on good nursing which builds up their resistance. Orders for the administration of drugs and feeds must be closely followed ; rigors need prompt treatment (para. 340) ; abnormal signs and symptoms must be observed and reported, cleanliness of the body maintained, and rest and sleep encouraged.

438. Meningitis.—The meninges are the membranes covering the brain, and they may be attacked by numerous kinds of germs, including the pneumococcus, the streptococcus, and the bacillus of tuberculosis (tuberculous meningitis). In cerebrospinal fever the organism is a meningococcus, which can usually be controlled with sulphonamides.

Whatever the cause of meningitis, the nursing care is the same. The patients sometimes show the same kind of cerebral irritation as is seen after head injuries (para. 277) and they should be kept as quiet as possible, preferably in semi-darkness. Headache may be intense, and very gentle handling is needed, especially in moving the head or back. Feeding may be difficult if the patient is only half conscious, and if he becomes comatose he may have to be fed through a nasal tube. If the eyes do not close normally they will need bathing from time to time to prevent infection and inflammation.

These cases are usually, though not always, nursed in isolation, and it should be remembered that discharges from the nose or throat will be infected.

Cold compresses or an ice-bag may be ordered for the relief of headache. Lumbar puncture is likely to be performed soon after admission to hospital, in order to obtain a sample of cerebrospinal fluid and identify the germ causing the meningitis. It may be required again later to ascertain progress or possibly to reduce pressure on the brain. Slowing of the pulse suggests an increase of pressure (compression) inside the skull, and this may lead to coma.

CHAPTER 56

THE INFECTIOUS PATIENT

439. Diseases are described as infectious when they can be communicated from one person to another. Such diseases are due to invasion of the body by germs and are spread by the transfer of germs from infected persons.

The chief infectious diseases in Great Britain are cerebrospinal fever, chickenpox, the common cold, diphtheria, dysentery, gastro-enteritis, infective hepatitis (jaundice), influenza, measles, mumps, pneumonia, poliomyelitis, rubella (german measles), scarlet fever, smallpox, tuberculosis, typhoid fever, undulant fever, and whooping-cough. Some of these spread much more readily than others.

Infectious diseases may be :—

Sporadic—isolated cases from time to time.
Endemic—confined to certain areas.
Epidemic—many cases in one locality.
Pandemic—a world-wide epidemic, such as the outbreak of influenza in 1918–19.

440. Spread of infection.—An infectious disease may be communicated :—

(*a*) *Directly*, by contact with a patient, or with his breath, excreta or any discharge.
(*b*) *Indirectly* by fomites (anything contaminated by a patient) ; by contacts (people who have been in touch with a patient) ; by carriers (people who, though not ill, harbour the germs) ; by flies and other insects ; and by water or food—especially infected milk.

Fomites include the patient's clothing, bed-linen, feeding utensils, toilet articles, and books.

Contacts are people who are, or have been, in close association with a patient during the infective stage of the illness. It is sometimes necessary to isolate contacts in case they may have caught the disease and will spread the infection while it is developing. Naturally the period of their isolation (*quarantine*) will differ for different diseases, according to the time that usually elapses between infection and the appearance of the first signs and symptoms (the *incubation period*). To be on the safe side, the quarantine period, reckoning from the date of contact with infection, is usually a few days longer than the incubation period.

Carriers are people who, though themselves healthy, carry the germs of a disease in their noses, throats or intestines and may thus convey it to others. People who have recovered from a disease sometimes continue to be carriers for a long time. Typhoid fever, dysentery, diphtheria and cerebrospinal meningitis are often spread in this way.

Flies convey infection because they are apt to settle on infected food or excreta, and pick up germs with their hairy legs or by eating. They deposit germs on other food, either with their legs or by vomiting infected food that they have eaten. Other insects that may spread infection are mosquitoes (malaria), fleas (plague) and lice (typhus).

Thus infection enters the body by :—

Inhalation, when the germ is breathed into the nose or lungs (inflenza and tuberculosis).

Ingestion, when it is swallowed with infected food (typhoid fever and dysentery).

Penetration of the skin either by insect bites (malaria and typhus fever) or through wounds (tetanus and erysipelas).

441. Stages of illness.—Infectious diseases pass through definite stages. The length and nature of these stages differs in the different diseases.

1. *Incubation period.*—The germs are multiplying in the body until their numbers are sufficient to produce toxins in large quantity.

2. *Invasion period.*—The toxins cause characteristic signs and symptoms. These are :—

General feeling of illness (malaise) ; sometimes vomiting and shivering.
Rise of temperature and pulse-rate.
Headache and other aches and pains.
Thirst, furred tongue, and sordes in the mouth.

3. *Febrile* (*feverish*) *stage.*—Signs and symptoms are intensified. The temperature reaches its maximum, and a rash may appear.

4. *Convalescence.*—The patient gradually regains his normal health.

The *isolation period* is the time during which the patient is still infectious and must remain isolated.

442. Nursing care.—The fact that a disease can be transferred from one person to another does not necessarily mean that it must be nursed in an isolation ward. Cases of

pneumonia, which is somewhat infectious, are normally admitted to general wards, and patients with typhoid, cerebrospinal fever, or tuberculosis, can be treated beside other patients, provided due precautions are taken.

Isolation wards should be well ventilated, with windows open, and are best kept at a temperature of about 60° F. No unnecessary furniture, carpets or curtains are allowed.

Special measures are required to prevent the spread of infection. These may include: (*a*) disinfection of the patient's clothes, bedding, utensils, and other articles; (*b*) protection of attendants by gowns, masks and special clothing; and (*c*) precautions taken by attendants lest infection of their hands, clothing, or utensils may spread the disease to others.

The actual nursing is on the same lines as for other patients, but there are additional duties. These include special care of the mouth and throat in diphtheria, scarlet fever, and cerebrospinal fever; and of the skin in smallpox and chickenpox; and scrupulous attention to disinfection at all stages of the disease, whatever it be.

Conveyance of meals.—Trays, utensils and crockery used in an infectious ward should be clearly marked with red paint. After use they must be sterilized before they are returned to the cookhouse.

Convalescence.—Patients convalescing from different infections should not mix or come in contact with one another in any way.

Procedure on discharge.—The patient is taken by the orderly to the bathroom, where a full bath, with 1 oz. Lysol in the water, has been prepared beforehand by another (non-infected) orderly. The patient must wash his head thoroughly. The orderly from the infectious ward takes away the patient's infected clothes for disinfection, and swabs the bathroom with cresol solution. A non-infected orderly then brings clean clothes, previously disinfected. When the patient is dressed, he goes to a non-infected ward or room to await discharge; he must on no account return to his old ward.

Disinfection.—Full instructions for disinfection are given in Regulations for the Medical Services of the Army.

443. Rules for the orderly.—A nursing orderly in an infectious ward must remember two facts—he may himself be liable to contract the disease and he may convey infection to others. To guard against these dangers he should keep the following rules:—

(*a*) *When coming on duty*, remove tunic, and put on an overall; also, if ordered by the sister, a cap and mask.

(*b*) *While on duty*, never eat or drink. Avoid unnecessary contact with the patient, and, after touching him (or infected articles) wash the hands in a solution of biniodide or perchloride of mercury (1 in 2,000), or Lysol (1 in 40) ; change overalls, caps and masks, when soiled. If feeling unwell do not try to stay on duty but report at once to the sister or medical officer.

(*c*) *When coming off duty*, first take off the overall, fold it carefully (with the exposed surface to the inside), and lay it on the shelf reserved for the purpose. Wash, with special care, the face and hands, and brush the nails.

(*d*) *While off duty*, try to get plenty of exercise in the open air. Keep the nails cut and the hair short. Gargle three times a day. Have a proper meal before coming on duty again.

444. Antiseptics.—Those chiefly used in infectious wards are :—

Dangerous antiseptics.—Perchloride of mercury, 1 in 2,000 ; biniodide of mercury, 1 in 2,000.

Non-dangerous antiseptics.—Cresol solution, $2\frac{1}{2}$ per cent. ; carbolic lotion, 1 in 20 ; formalin solution, 8 oz. to 1 gallon.

The mercurial solutions are used to disinfect the hands ; the cresol to soak linen and to clean bedpans and urine bottles ; the carbolic to clean forceps, tongue depressors and similar metal articles ; and the formalin to soak linen, or to wash iron bedsteads. (Commercial formalin is a 40 per cent. solution of formaldehyde).

SECTION VII.—FOOD AND COOKERY

CHAPTER 57

FOOD AND NUTRITION

445. Food is required by the body :—

(*a*) To build up new tissues during growth.

(*b*) To replace the material lost in the constant wear and tear to which all the tissues of the body are subjected.

(*c*) To provide energy for the maintenance of warmth and of the vital processes of the body, such as respiration, circulation and digestion ; and for the performance of muscular work.

Therefore food may be defined as anything that, taken into the body, is capable of supplying material for growth and for the repair of waste ; or of furnishing energy when oxidized (*i.e.* burned at a very slow rate) in the body.

Essential Foodstuffs

446. The essential constituents of food are :—

Proteins.
Carbohydrates.
Fats.
Certain substances, known as vitamins, present in small amounts in natural foodstuffs and necessary for the maintenance of health.
Mineral substances.
Water.

Proteins, carbohydrates, and fats have to be broken down by the digestive juices before they can be absorbed and used. These changes take place in the alimentary canal.

447. Proteins.—These are complicated nitrogenous substances. Since the living matter (protoplasm) of every cell consists largely of proteins, they are required to form new tissue, either in growth or in the replacement of tissue wear and tear, and they are therefore essential constituents of every dietary.

The chief protein foods are meat, fish, milk, cheese and eggs ; proteins are found in smaller amounts in vegetables, especially the pulses (*e.g.* peas and beans). Vegetable protein

is of less value in building new tissues or repairing waste than an equal amount of animal protein.

Any protein not utilized for the formation of new tissue is oxidized in the body and yields energy.

448. Carbohydrates and fats.—The chief carbohydrates in foods are starches and sugars; during digestion the starches are broken down into sugar (glucose), and absorbed from the alimentary canal as such. Carbohydrates form an important part of the diet because they lessen the amount of protein food that has to be oxidized; more protein is thus made available for the formation of new tissue. Also sugar is the most readily available source of energy for muscular activity. The chief carbohydrate foods are the cereals (flour, oatmeal, rice), sugar and preserves, potatoes, and, to a lesser extent, fruit and vegetables.

Fats are derived both from animal sources (meat fat, lard, suet, butter) and from vegetable sources (margarine, salad oil). Fat forms an important part of the dietary, because—weight for weight—it yields more than twice the energy of either protein or carbohydrate, and thus allows an adequate intake of energy-producing food without excessive bulk.

The carbohydrates and fats are the chief sources of the energy required for work and for the maintenance of heat and other vital processes. A diet containing more carbohydrate or fat than is required for the production of such energy leads to the storage of surplus fat; whereas if the diet contains less than the required amount, the body has to make good this deficit by utilizing fat already stored.

449. Accessory food factors (vitamins).—These may be defined as substances which the body is unable to manufacture itself, but which it requires for health and obtains from natural foods. The vitamins are of widely different chemical nature, but can be divided into two main groups, those soluble in water, and those soluble in fats and oils.

450. Water-soluble vitamins.—Many substances in this group have been recognized.

Vitamin B_1 (*aneurin*) is present in most natural foods, especially yeast and wholemeal cereals, while egg-yolk, organ meats, pork, the pulses and nuts are also relatively rich sources. Milling of cereals removes most of the vitamin, so that white flour and polished rice contain only very small amounts.

It is destroyed by heat, and cooking causes some loss varying with the nature of the foodstuff and the method of cooking. The high temperatures used in the processing of tinned foods cause considerable destruction of vitamin B_1.

A diet consisting mainly of tinned foods is therefore likely to be deficient in this vitamin, but can be supplemented by yeast tablets, or tablets containing artificially manufactured vitamin B_1.

Its destruction by heat is aggravated in the presence of alkali. The use of soda in the cooking of green vegetables therefore reduces their vitamin-B content and is to be strongly condemned.

Being soluble in water, the vitamin tends to be extracted into the water used in cooking. If this cooking water is discarded, considerable loss of vitamin B_1 results.

Vitamin B_1 is necessary for the normal utilization of the carbohydrates in the body, and, if the diet is deficient in this vitamin, an affection of the nerves (neuritis) and of the circulatory system results. When the deficiency is severe, the resulting disease is known as beri-beri.

Vitamin-B_2 complex.—This comprises several different vitamins, of which two are known to be important in human nutrition: (*a*) nicotinic acid, lack of which leads to the disease known as pellagra, characterized by diarrhœa, mental changes, and a peculiar skin eruption on those parts exposed to sunlight, and (*b*) riboflavin, lack of which causes an affection of the skin and eyes.

The richest sources of the vitamin-B_2 complex are yeast, eggs, milk and cheese, organ meats, and the pulses. The substances comprising it are not destroyed by heat, but, being water-soluble, they tend to be dissolved out into the water used in cooking.

Vitamin C (*ascorbic acid*) is found chiefly in green leafy vegetables, citrus fruits (oranges, lemons), berries, and currants. Potatoes also contain a fair amount.

The vitamin-C content of green vegetables, and, to a much less extent, of fruit, decreases rapidly after their removal from the ground or plant, and therefore leafy vegetables should be used as soon as possible after issue.

Vitamin C is destroyed by heat, and considerable loss may therefore occur in cooking. In the case of leafy vegetables, however, more vitamin is dissolved in the cooking water than is destroyed by heat. Thus it is important to retain this water for use as stock.

Commercial canning of foodstuffs causes about the same destruction of this vitamin as household cooking.

Deficiency of vitamin C in the diet causes the disease known as scurvy, which is characterized by swelling and bleeding of the gums; bleeding under the skin, into the muscles, and under the periosteum of the bones; and great weakness and anæmia.

A diet lacking in foods rich in vitamin C can be supplemented by tablets containing artificially manufactured ascorbic acid.

451. Fat-soluble vitamins.—Two of these require notice. *Vitamin A* is found in two forms in nature, either (*a*) in animal fats and organs (the richest sources are liver, milk, butter, cheese, egg-yolk, the body oils of fatty fish and the liver oils of all fish); or (*b*) as a yellow plant pigment known as carotene, which occurs in green and yellow vegetables of all kinds and is converted in the body into vitamin A.

Vitamin A and carotene are not affected by the temperatures used in cooking, and, being insoluble in water, are not dissolved in the cooking water. Vitamin A is essential for normal growth.

Deficiency of this vitamin is shown first by difficulty in what is known as "dark adaptation"—the ability to see when passing from a bright light to darkness. If the deficiency is more severe, a peculiar skin condition develops; the eyes become dry through lack of tear secretion and may thus be infected; and degenerative changes take place in the various living membranes of the body, rendering them more liable to invasion by germs.

Vitamin D is present in only a few foods. Its chief sources are the liver oils of fish, the body oils of fatty fish, and, to a lesser extent, such substances as butter and egg-yolk. The human body also obtains a supply through the action of the ultra-violet rays of sunlight on a certain fatty substance present in the skin. This latter supply is probably adequate for the adult, but infants and children require a supplement in the food, especially in winter.

Deficiency of vitamin D in childhood causes rickets. In this disease the bones soften and bend, because they are not receiving the necessary amount of lime.

452. Mineral substances.—Mineral salts, especially those of calcium, phosphorus, iron, magnesium and iodine, are as essential for health as the vitamins. Most of these salts are obtained in sufficient amount in any ordinary diet; but calcium, found especially in milk and cheese, and iron, chiefly derived from meat and vegetables (especially the pulses), may be deficient unless care is taken to ensure a proper intake of them.

The only mineral which is added to the diet is common salt. While salt improves the flavour of foods, it is not a necessity in temperate climates; but in hot climates it must be used to make good the salt lost in sweat.

453. Water.—Water is essential in nutrition, for all the vital processes of the body take place in a fluid medium.

Foodstuffs are brought to the various parts in solution ; waste-products are carried away for excretion in the same way.

Water is constantly being lost by the body either in the urine, the sweat, or (as water vapour) in the expired air. It is not taken in solely as a liquid, but it forms a large proportion of the so-called solid foods. For example, bread contains about 35 per cent., meat about 70 per cent., and vegetables from 85 to 95 per cent. of water.

Energy and Diet

454. Food which is not used for maintenance purposes, or to make up weight lost through illness, is oxidized in the body to produce energy. Some of this energy is used to promote the vital functions, and for the performance of muscular movements ; but the greater part appears in the form of heat, which keeps the body at the proper temperature.

455. Energy value of foods.—The energy value of different foods can be ascertained by estimating the amount of heat produced when a definite amount of the food substance is completely burned (oxidized). The unit used to measure this heat is called a calorie. One calorie is the amount of heat required to raise the temperature of one kilogramme of water one degree Centigrade.

Carbohydrates and fats are completely oxidized in the body to water and carbon dioxide. Proteins are not completely oxidized.

The energy values of the three chief constituents of food, when oxidized in the body, are as follows :—

Carbohydrate	4 calories per gramme.
	114 calories per ounce.
Fat	9 calories per gramme
	256 calories per ounce.
Protein	4 calories per gramme.
	114 calories per ounce.

Therefore if we know the composition of a food, its approximate energy value is easily calculated from the above figures. Milk, for example, contains roughly 3 per cent. protein, 4 per cent. fat, and 5 per cent. carbohydrate ; therefore 100 grammes of milk (about 3½ ounces) will provide the following calories :—

Carbohydrate	$5 \times 4 = 20$ calories
Fat	$4 \times 9 = 36$ calories
Protein	$3 \times 4 = 12$ calories
Total	68 calories

456. Energy requirements.—The energy needed by a man of average weight to maintain the warmth and vital processes of the body—in other words, to keep the body alive—is about 1,680 calories per twenty-four hours.

A further supply of energy is required for the performance of muscular movements, and this amount depends largely on the work done. The mechanical energy liberated in the normal "up and about" activities, together with a moderate amount of muscular work, is equivalent to about 400 calories.

Of the total energy value of the food, the human body can only convert one quarter into energy available for work; the remainder is converted into heat. Therefore, to provide 400 calories for the performance of muscular movements, the body must oxidize 1,600 calories. To this must be added the 1,680 calories required for maintenance of the body's vital functions. Therefore the total daily requirement from the food for a man carrying out moderate muscular work is almost 3,300 calories.

But not all the energy which could be derived from the raw foodstuffs in the daily diet is available to the body. Some is lost before cooking, when unsuitable parts are thrown away; some in cooking, as, for example, the fat which sticks to the pans; and some at the table, where unpalatable portions, such as gristle, are put aside. Also a certain amount of food passes through the body without being absorbed. An allowance of from 10 to 20 per cent. must be made for these losses.

Modifying factors.—For a soldier engaged on light duties the ration should contain about 3,500 calories. The following factors modify this figure :—

(*a*) *Muscular work.*—A soldier engaged in hard training, or on active service, requires at least 4,000 calories.

(*b*) *Individual weight.*—A big man needs more food than a small man to replace tissue waste and loss of body heat.

(*c*) *Clothing.*—If insufficient clothing is worn, heat is lost more rapidly, therefore more food is required to replace it.

(*d*) *Climate.*—The ration in a cold climate should yield from 4,500 to 5,500 calories to compensate increased rate of loss of heat. In a warm climate heat-production by the body is not decreased; therefore food requirements are unchanged, and heat must be allowed to escape by reducing the amount of clothing.

457. Diet.—As has been stated, food must supply not only energy but also protein for tissue formation, and the vitamins

and minerals necessary for the maintenance of health. Foods may be divided into these three groups, and the diet must contain a sufficient amount of each :—

Body-building foods.—These are rich in protein ; they include meat, fish, milk, eggs, cheese and the pulses.

Energy-yielding foods.—These are starchy foods, such as the cereals, potatoes, sugar and preserves ; and fats, such as butter, margarine and lard.

Protective foods.—These yield the minerals and vitamins essential for health. Among the more important are liver, dairy products, green leafy vegetables, wholemeal cereals and fruit.

CHAPTER 58

INSPECTION OF FOOD

458. The steward should be well acquainted with the characteristics of fresh food, and be able to detect foodstuffs which are not up to contract or have become unfit for issue. The cook should know the various " cuts " or joints into which carcases of beef, mutton, pork, etc., are divided, and be able to judge foodstuffs as to quality and fitness for human consumption.

MEAT

459. Condition of meat.—The conditions of contract require that meat shall be " well-fed, good, sound, sweet and wholesome." It is also usually stipulated that ox beef shall be not under 2 or more than 5 years old, and heifer or cow beef not under 2 or more than 4 years.

Meat may be divided into three classes :—

(*a*) Home-bred and home-killed, including every kind of bull, ox, cow, heifer, sheep and pig.

(*b*) Foreign-bred, but killed in Great Britain. This class is principally beef of good quality, the animals having been well fed.

(*c*) Refrigerated meat, of which there are two kinds, " frozen " and " chilled." Frozen meat consists of meat that has been pre-cooled at 35°–40° F. and then kept at temperatures below 32° F. (usually 10°–15° F.). Chilled meat is kept at somewhat higher temperatures, usually 28°–30° F. Meat originally chilled, but afterwards frozen, is termed " hard-chilled."

Frozen meat can be distinguished, before it is thawed, by its hard cold touch, white fat, and pale red muscle ; and possibly particles of ice may be seen in its substance. When thawed, there is a considerable amount of "weeping" due to the melting of the ice contained in the meat, so that the cut surface feels spongy and watery.

Chilled meat has hard, pink, slightly bloodstained fat, and bluish muscles, easily distinguished from the yellowish fat and red muscles of home-killed meat. After thawing there is a certain amount of "weeping," though not so much as in frozen meat ; the surface is soft and spongy and lacks the lustre and clean firm appearance of home-killed meat.

Hard-chilled meat presents some of the characteristics of both chilled and frozen meat ; the fat is pink, very hard and firm ; the muscle is not so spongy as in frozen meat, nor is there so much weeping.

De-frosting or thawing must be very gradual in a temperature not exceeding 50° F. The carcase must be unwrapped, hung clear, and any weeping caught and retained for use in the stock-pot. Such hung meat is very susceptible to odours, so that disinfectants must be used with care. Only sufficient meat for current use should be de-frosted, as a second freezing is inadvisable.

Bone taint is a condition confined almost entirely to imported meat. It is characterized by putrefactive changes in the region of the pelvic bone, and to a lesser extent the shoulder-blade ; it is accompanied by a peculiar smell, which may be most objectionable. Bone taint is not usually discovered until the carcase has been thawed and jointed by the butcher, although it may be detected by inserting a skewer into the region of the pelvic bone, leaving it for a moment or so, then withdrawing it and applying it to the nose. The condition is dealt with by cutting out and discarding the tainted bone and adjoining flesh ; then the rest of the carcase is hung until it is free from smell. It is then fit for use.

Moulds occasionally affect meat ; the commonest varieties are "black spot" and white mould or "whiskers." The former shows as scattered black spots about ½ inch in diameter ; it may penetrate beneath the surface to a depth of ¼ inch. Affected meat is trimmed so that the mouldy portions and surface are removed. White mould is entirely superficial, and it is removed by hard rubbing with a dry cloth.

Brine stains are sometimes seen, although previous inspections and examinations should prevent the issue of meat thus affected. The stains, which vary in colour from buff to

greenish-black, are caused by leakage from the pipes containing the freezing mixture. The treatment is to cut away the affected part till unstained flesh is reached.

460. Beef.—A healthy carcase of well-fed beef has externally a round well-filled appearance. The muscle or flesh should be soft and silky to the touch, full of juice and of a slaty-blue colour.

In a freshly cut joint the colour changes in a few minutes to a bright cherry-red as the result of exposure to the atmosphere. The flesh should be elastic under slight finger pressure, and free from any tendency to "pit"; moist without being wet, and well mottled or marbled with fat.

In the old cow there will be a total absence of marbling; the lean will be harsh and stringy to the touch, duller in appearance and deficient in juice; and there will generally be little fat. In the old bull the flesh is dark in colour, and feels like indiarubber; marbling is absent, and there is much more muscle than fat.

The colour of the fat varies from cream or pale straw to bright yellow. It should be well set. The amount of fat in a carcase should be about 53 per cent. of the total weight, and the proper proportion of bone is from 17 to 20 per cent.

The various joints into which beef is cut are described in R.A.S.C. Training, Volume III (Supplies).

461. Mutton.—The fat in good well-fed mutton should be firm and white and fairly abundant. A common complaint is that it is too fat, but good mutton is unobtainable without a fairly high proportion of fat. The muscle should be red, soft and silky to the touch, moist without being wet, and slightly elastic under the pressure of the finger. There is sometimes a little marbling, but it is rare. The division of the carcase into joints is described in R.A.S.C. Training, Volume III (Supplies).

462. Bacon.—The lean parts should be pale pink (a very red colour denotes a high percentage of salt). The fat should be white and firm to the touch, the rind thin. Any tinge of colour in the fat is suspicious. Bacon is tested by inserting a skewer or knife into the fleshy parts of the meat and smelling the point or blade when withdrawn. There should be no unpleasant odour.

Fish, Poultry, Rabbit

463. Fish.—In *fresh fish* the eyes should be prominent and bright, the gills bright red in colour, the flesh firm and stiff. When pressed with the finger, the flesh should not pit, and there should be no unpleasant smell. All fish, when delivered,

should be cleaned, unbruised and unbroken. A pinkish colour along the backbone of white fish is a sign of staleness.

Cured fish.—The fish should present a wholesome shiny appearance. If there is any doubt about its freshness, an incision should be made in the thick part of the flesh near the backbone; if there is any unpleasant smell the fish must be rejected.

464. Poultry.—*Fowls* should be young, fresh and in good condition, weighing not less than $1\frac{1}{2}$ lb. or more than $1\frac{3}{4}$ lb. when trussed. Signs of age are stiff horny feet, long spurs, dark hairy thighs, and stiffness of beak and bones.

There should be no smell, and no discoloration of the skin. The back generally discolours before the breast. The feet should be limp and pliable; stiff dry feet are a sure indication of a stale bird. The flesh should be firm and not flabby, and the bird should be plump; the breast-bone is sometimes broken across to produce this appearance.

Turkeys are usually supplied to patients in hospital at Christmas. They are best of medium size, weighing about 10 to 12 lb. The skin of young birds is soft and smooth, not coarse and irregular as in older birds. The lower part of the breast-bone should be pliable, the legs dark. Hen turkeys are considered the better for cooking.

465. Rabbit.—Rabbit is often issued to hospitals instead of chicken.

Freshness is denoted by the flesh feeling firm and elastic, even if a little moist, by its pinkish or slightly bluish colour, and fresh smell. The abdominal fat should smell sweet and the carcase be free from bruises. Decomposition is marked by a wet flabby condition of the flesh which assumes a bluish-grey colour and an offensive odour.

Old rabbits can be distinguished by their blunt claws and dry ears.

Eggs, Milk, Butter

466. Eggs.—The average hen's egg weighs about 2 oz. To ascertain the freshness of an egg, hold it up to the light; if the centre appears to be the most transparent part, it is a sign of freshness. Stale eggs are more transparent at the larger end. Another method is to place the eggs in brine—a solution of 8 oz. of salt in one gallon of water. Fresh eggs will immediately sink. Stale eggs will float. Stale or small eggs should be rejected.

467. Milk.—Cow's milk enters largely into all dietaries. Every care must be taken to use it when fresh, because, owing

to the action of germs, lactic acid is formed after some hours and the milk becomes sour. The cleaner the milk, the longer it will keep fresh and sweet ; so the vessels in which it is kept should be perfectly clean, and it must be protected from dust (which always contains germs). The lower the temperature at which it is kept, the longer will the milk remain sweet. Homogenized milk will not show a cream line.

The specific gravity ranges between 1030 and 1034 at 60° F.

Good milk should be a full opaque white ; or it may have a very slightly yellowish tinge, best seen by placing it in a glass on a sheet of white paper. It should have a slight agreeable odour, and characteristic sweetish taste. An objectionable sweetish taste is sometimes present : the cause of this is that the cows are being fed on turnips and turnip-tops, and the contractor should be informed at once. Such milk is easily detectable in light milk dishes such as egg flips, sweet soufflés and light custards.

The chief adulterations are :—

(*a*) the addition of water ;

(*b*) the removal of part of the cream, with or without the addition of water.

Addition of water lowers the specific gravity, and, generally speaking, there is a loss of three degrees for every 10 per cent. of water added. On the other hand, removal of the cream (skimming) raises the specific gravity ; so in milk that has been creamed and watered the specific gravity may be normal. The test of specific gravity must therefore be used together with the estimation of the cream present.

468. Butter.—Butter is made by churning, either from the milk directly, or from cream that has already been separated. It should be a good rich yellow, and should have a pleasant and characteristic smell and taste. The taste may be slightly salt, but it should not be in the least rancid or bitter.

Its keeping qualities depend greatly upon the percentage of casein it contains ; if the casein content is high, as in butter made from sour milk, the keeping value is reduced. Common salt is often added to preserve butter ; it should not be more than 3 per cent. Butter can absorb odours and volatile flavours, and, if the cows have been fed largely upon swedes or turnips, butter made from their milk has an unpleasant flavour. Any abnormal taste is accentuated by heating. Butter which has been insufficiently churned will exude drops of milk when pressed and is likely to go sour. Canned butter is vacuumed and processed in the same way as canned foods.

Margarine is largely used as a butter substitute. The characteristics of butter (flavour and smell) are given to margarine by the addition of milk, and nut and other oils. The proportion of butter fat is limited to 10 per cent., and the percentage of water is restricted to 16.

Vegetables, Cereals, Canned Foods

469. Vegetables.—Fresh vegetables and fruit should not be used if they have become stale. (Vitamin-C content is reduced on storage). If received in bulk, above-ground vegetables must be removed as soon as possible from the bags or boxes containing them and laid out separately on shelves to allow free access of air. This prevents fermentation and decay. They should be kept in a cool damp place to avoid wilting. (Vitamin-A potency is reduced by wilting.) Root vegetables are kept in their bags with the mouths held widely open to allow access of air. Precautions must be taken to avoid crushing or bruising, which increases the rate of destruction of vitamin C.

470. Cereals.—Wheat, barley and oatmeal, if old or stale, have a greyish dull appearance. The same remarks apply to manufactured products such as cornflour, flour, ground rice, macaroni, rolled oats, sago, semolina and tapioca.

The skin of butter beans, haricot beans, dried peas and lentils shrivels when they are old.

471. Canned Foods.—The canning process is carried out by heating the foodstuffs to a temperature of 115° to 120° C., and then closing the tin so that all air is excluded. The heat kills all germs, and, by closing the tin while the contents are still hot, a partial vacuum is formed when it cools, owing to the contraction of the air. This contraction sucks in the ends of the tin, making them slightly concave.

In a damaged tin, or in one whose contents have not been completely sterilized, putrefaction may set in, and gas is formed which bulges out the ends of the tin. Such a tin is said to be " blown " and should be rejected.

The contents of a tin containing food should be emptied out as soon as it is opened.

CHAPTER 59

METHODS OF COOKING

472. The reasons for cooking food are :—

(*a*) To make it more palatable.
(*b*) To loosen the muscular fibres in meat.
(*c*) To break down the starch grains in vegetables.
(*d*) To make it more appetizing to the sight, taste and smell.
(*e*) To destroy bacteria and parasites by heat.

Unless the heat employed in cooking foods is used scientifically, the best results will not be obtained, and much of the essential vitamins and mineral salts will be destroyed, or partially destroyed, in the process. Long heating at low temperatures is more destructive to vitamins than short exposures to high temperatures ; hence the undesirability of a diet containing too many stews and hashes.

473. Roasting.—Meat or poultry to be roasted should be put in a baking tray, well basted with dripping, and placed in a very hot oven for just sufficient time to seal the pores of the flesh and so prevent loss of nutritious juices during the later cooking process. The tray should then be withdrawn and cooking should proceed at a lower temperature (approximately 350° F.).

The time required to roast is about 15 to 18 minutes for each 1 lb. weight, but this time depends on the thickness of the joint, the quality of the meat, and the size of the bird. Young and fat meat requires longer cooking than old and lean meat. Veal, lamb and pork take somewhat longer than beef or mutton, and after the preliminary stage of quick roasting should be cooked more gently.

Frequent basting increases tastiness and succulence.

474. Baking.—This is a convenient, economical and satisfactory method of cooking certain dishes, such as pastry, pies, pork and other meats, fish, poultry, puddings, and cakes.

When baking meats or poultry, prepare a bed of thickly sliced potatoes in a baking tray. Place the joint or bird on this bed, season, baste with dripping, and proceed as for roasting. Pork should be covered with greased paper to prevent the fat from melting too quickly.

Pies should at first be placed in the hottest part of the oven. When the paste is cooked they can be left on the bottom to simmer until cooked.

475. Braising is a combination of roasting and stewing, and is employed mainly in cooking inferior joints, poultry, offals and certain vegetables.

Meat or poultry should be first larded with pieces of fat ham or bacon and next coloured quickly in a very hot oven with a layer of vegetables, such as carrots and onions; it is then moistened with brown stock, covered with a lid and replaced in the oven to braise. Meat so treated not only retains its own juices but also absorbs the flavour of the vegetables with which it is cooked.

476. Boiling is a simple method of either :—

(*a*) Cooking foods while retaining their natural juices.

(*b*) Extracting nourishment, as in the making of stock, beef tea or chicken broth.

To retain their juices, meat or poultry must not be put into the pot until the water is actually boiling. The water, which should be seasoned with salt, must boil briskly for 10 minutes to harden the albumin and so retain the juices; cooking is then completed by gentle simmering. There should be plenty of water, and the lid of the vessel must be kept on, care being taken to remove any scum as it rises to the surface.

Salt beef or pork should be soaked and washed in cold water, after which it is placed in a vessel containing cold water and allowed to boil steadily.

When it is desired to extract bone, meat, or vegetable juices, the food is cut into small portions, placed in cold water, and brought slowly to the boil, removing the scum which will rise at intervals. Then simmer until all possible juices have been extracted into the liquid.

Root vegetables intended to be served separately should be placed in cold water with a little salt, brought to the boil and cooked until tender. Cabbages and other green vegetables should be thoroughly cleaned and allowed to remain in salt water for a short time to destroy any remaining impurities. They should then be placed in *boiling salted water* and boiled quickly; when tender they are taken out, strained, and served very hot, as quickly as possible after cooking.

477. Steaming is performed by passing steam from a closed boiler to a closed chamber or wet steaming oven; or by placing a steamer over an open boiler containing boiling water; or by placing a few bricks at the bottom of a boiler, covering them with water and placing on them the dish containing the food to be cooked.

A steamer is a vessel the bottom of which is perforated. It should never be placed above a boiler until the water is at a sharp boil.

Although in many respects steaming has the same effects as boiling, it is a more gradual process and allows the natural juices to be retained more completely. It is a satisfactory and economical means of cooking puddings and potatoes.

478. Stewing is considered the most economical method of cooking. If it is properly performed, tough meat is made tender and palatable, and more nourishment is retained than with any other cooking process. Meat of fibrous and coarse nature such as legs, briskets, buttocks, clods or necks of mutton, should be stewed.

It should be distinctly understood that stewing is not boiling, but gradual simmering. Before stewing, meat should be lightly covered by frying in a little dripping ; this adds flavour and colour to the dish.

479. Frying is cooking with the aid of fats, which should be sweet, clean and free from salt. There are two methods—deep and shallow.

(*a*) *Deep frying* is cooking by immersion in fat or oil heated to about 420° F. The hot fat must be deep enough to cover the food. When it is at the right temperature, the fat will be still, not bubbling, and should give off a light bluish smoke. If the fat is not hot enough, anything put into it will become sodden, greasy and unpalatable.

Deep frying is used for fish, meat rissoles, and fritters. Foods to be fried—except those covered with paste—should be dipped in batter, or egged and crumbed before cooking.

(*b*) *Shallow frying* is used for steaks, cutlets, chops, bacon, eggs, liver, and kidneys. Only a small quantity of fat should be employed—just enough to cover the bottom of the pan. Allow the fat to get thoroughly hot, without burning. During cooking, turning is necessary to prevent hardening or burning, especially with meat.

480. Grilling or broiling is cooking over a fire, or in front of a fire, a gridiron being generally used. A bright clean and strong coke fire gives the best results. The gridiron must be scrupulously clean and well greased every time it is used. It should be placed in a sloping position at a convenient height above the fire ; this prevents the melted fat from dropping into the fire and so causing smoke and flame.

From 10 to 12 minutes is all that is needed to cook a 6 oz. chop or steak, which should be served at once while hot. Turn

once only with a pair of tongs when the blood percolates. Cutlets, chops, birds, fillets, steaks, slices of cod, haddock, whiting and soles are suitable for grilling.

481. Average loss in cooking meat.—The approximate percentage of weight lost in cooking meat is as follows :—

Roasting	30
Baking	25
Boiling	20
Braising	15–20
Stewing	15–20
Steaming	15

482. Salting meat.—The quantity of common salt required for a mild brine is 2 lb. to the gallon of water. Saltpetre is added to give an attractive pink colour, but in excess it will harden the meat, so ½ oz. to the gallon of water should not be exceeded.

Boil the water, place it in a wooden tub (free of metal fittings) and add the salt. To ensure its solution and distribution in the brine, dissolve the saltpetre in a little warm water and add it to the other ingredients in the tub. Stir well to mix thoroughly.

A raw potato will float in brine which is ready for use ; if the potato sinks more salt must be added.

The minimum period for pickling is 5 days.

Souring of the brine is caused by organisms and formation of scum. Removal of this scum will lengthen the brine's life.

A brine can be used repeatedly, provided that it is strained and boiled after each use. Test the strength and add additional salt or water if required.

Before placing the meat in the brine, it should be put in clean cold running water for about a quarter of an hour to remove surface organisms ; this will also tend to open the texture of the flesh and make it more receptive to brine penetration. Secure all joints with string, so that they can be removed without dipping hands into the brine. As exclusion of air from the meat is important in the process of pickling, a wooden float can usefully be employed to keep the meat below the surface.

No amount of salting will make tainted meat sound. Tainted meat will also sour the brine and affect any other meat that happens to be in it.

Briskets.—The skirt should be trimmed out with a boning knife, and the breast-bone and cartilages removed. Trim off the hard fat on the outside, as no amount of cooking will make it tender.

Silversides.—Remove the marrow-bones and trim the kernel out.

483. Clarifying fat.—Surplus fat should be cut into small pieces and passed through a mincer. The minced fat is put into a dish or pan, barely covered with water, and placed in an oven or over a fire and allowed to boil rapidly until all the water has evaporated and the fat is light brown. It is then allowed partly to cool, strained through a press, colander or sack (the crackling must be well pressed), poured into clean dishes, allowed to harden, turned out and scraped clean.

If the fat is dirty or dark brown it has either been indifferently clarified or burnt. Fat that is at all scorched will taint anything it may be mixed with. Liquid fat accumulating on the surface of stocks, or stews, and that which settles at the bottom of baking trays, must be carefully removed, put in a dish to cool and allowed to harden. It should then be clarified.

484. The stock-pot.—A stock-pot will be kept in every kitchen to provide the liquor required for various purposes, but mainly for the preparation of gravies, sauces and soups. A large boiling-pot, copper boiler or steam vessel can be used for this purpose, and it should be provided with a tap.

Proportion of ingredients for making or starting a stock-pot :—

2 quarts of water to every 2 lb. of bones.

One carrot, one onion and one turnip to every 2 lb. of bones.

Salt.

(1) Chop the bones into small 4-inch pieces. (2) Put the bones in the pot, sprinkle with salt and add the water. (3) Bring slowly to the boil and remove all scum as it rises. (4) Wipe the sides of the pot, add a pint of water and reboil. (5) Remove any further scum and simmer for 2 hours. (6) Wash, peel and scrape the vegetables, add them, and simmer for a further 4 hours. (7) Remove vegetables, remove fat and place in a basin, strain the stock, reboil and use as required.

At the end of the day, any stock not used must be carefully reboiled, drained into a clean receptacle and placed in the larder on a wooden frame or two bricks, to permit a free current of air round the bottom and sides. Fat skimmings should be kept and clarified for second-grade dripping, and used in the preparation of savoury dishes and pastry. Vegetables employed in making stock can be used in soups, salads or as a garnish.

CHAPTER 60

RECIPES IN GENERAL USE

Soups

485. Soups are divided into four classes: clear soups, purées, thickened soups, broths.

Clear soups are made from clarified stock. The various garnishes added give them their distinctive names.

Purées are made by rubbing the materials for the soup through a sieve after cooking. The purée, or pulp, thus made is then stirred into the liquor of the soup, as in lentil soup or spinach purée. The sieve removes the tough lentil husks.

Thick soup.—Soups are thickened by the addition of either (*a*) flour, cornflour, rice flour, tapioca, semolina, small sago, potatoes or potato flour, or (*b*) a mixture of yolk of eggs and milk or cream.

Broth is stock made from beef, mutton, veal, chicken, etc. It is not clarified, and small pieces of the meat and vegetables are usually served in it, as in Scotch broth or mutton broth.

486. Julienne soup.

Clarified stock	4 pints	Cabbage... ...	2 outside leaves
Carrots	2	Leek or onion ...	1
Turnips	1	Margarine ...	1 oz.
Salt	pinch	Sugar	pinch

(1) Cut the vegetables in fine strips. (2) Melt the margarine in a saucepan, add the vegetables, salt and sugar, place a paper and a lid on top, and stew until tender without taking colour. (3) Toss over from time to time, add stock, simmer for 15 minutes, remove fat from surface, correct seasoning and serve.

Quantity sufficient for 8 persons.

487. Haricot bean (or lentil) purée.

Haricot beans or lentils	8 oz.	Carrot	1
Water	4 pints	Onions...	2
A few bacon bones or rind		Thyme, bay leaf	
Salt		Peppercorns	6

(1) Wash the beans or lentils and soak overnight. (2) Drain and cover with the water, add the salt and bring to the boil; skim thoroughly, add the diced vegetables, thyme and bay leaf, and the bacon bones or rind, and simmer for 1½ hours.

(3) Remove thyme, bay leaf, ham bones or rind, and peppercorns; then pass through a sieve. (4) Return to the saucepan and reboil. (5) Skim carefully and simmer for 10 minutes, removing the scum as it rises. (6) Correct seasoning and consistence, pass through a strainer and serve.

Quantity sufficient for 8 persons.

488. Tomato soup.

Tomatoes	3 lb.	Flour	1 tablespoonful
Bacon bones... ...	2 or 3	Sugar	1 teaspoonful
Small carrot ...	1	Salt	pinch
Onion	1	Dripping ...	1 oz.
Peppercorns ...	6	Stock	2 quarts
Celery	1 stick		

(1) Dip the tomatoes in boiling water, peel them and cut them into quarters. (2) Chop the bacon bones and fry them in the dripping; add the diced carrot and onion and fry to a golden colour. (3) Add the flour and cook on the side of the stove. (4) Add the tomatoes and stock and stir until boiling. (5) Season, add the sugar and simmer for 45 minutes. (6) Pass through a sieve, reboil, correct seasoning and consistence and serve.

Quantity sufficient for 4 persons.

489. Mutton broth.

Turnip	1	Clove	1
Small carrot ...	1	Peppercorns ...	6
Onion	1	Chopped parsley	1 teaspoonful
Celery	1 stick	Salt to taste	
Pearl barley ...	1 dessert-spoonful	Mutton stock	2 pints

(1) Blanch the barley and add it to the stock with the salt; bring slowly to the boil, skim, then simmer for 45 minutes. (2) Cut the vegetables into small dice, add them to the stock and cook slowly for a further 30 minutes. (3) When the soup is cooked, add the chopped parsley and (if available) a little diced cooked mutton.

Quantity sufficient for 4 persons.

490. Chicken broth.

Chicken stock ...	1 pt.	Faggot ...	1
Small onion	1	Chopped parsley	½ teaspoonful
Small carrot ...	1	Salt	pinch
Washed barley or rice	1 dessert-spoonful		

(1) Boil the stock and remove any fat. (2) Add the vegetables (cut into small dice), the salt and the faggot, and simmer for 30 minutes. (3) Add the washed barley or rice and cook steadily until tender. (4) Correct the seasoning; remove faggot and serve.

Quantity sufficient for 2 persons.

491. Chicken cream soup.

Chicken (legs or back) ...	8 oz.	White sauce	1 pint.
Veal or chicken stock ...	2 pints.	Small faggot	1
Carrot	1	Salt	pinch
Onion (stuck with clove)	1	Cayenne pepper ...	pinch

(1) Blanch the chicken, refresh and cover with stock. (2) Bring to the boil, skim, add salt, vegetables and aromatics, and simmer until the chicken is cooked. (3) Remove the flesh from the chicken (reserving a small portion for garnish), cut in julienne, pound the remainder in a mortar with a little white sauce, pass through a fine sieve, and add the rest of the white sauce. (4) Meanwhile strain the stock through muslin, add to the chicken purée, boil up and stir with a wooden spoon. (5) Correct the seasoning and consistence (to coat the back of a spoon) and pass through a strainer before serving.

Quantity sufficient for 5 persons.

492. Vegetable soup.

Stock	2 pints	Cabbage leaves	2
Carrots	2	Celery	1 stick
Leek	1	Barley or rice	1 tablespoonful
Small onion	1	Margarine ...	½ oz.
Turnip	½	Salt	pinch
Potatoes	2		

(1) Melt the margarine in a saucepan, add the diced carrot, leek, onion, cabbage leaves and turnip. (2) Cover with a lid and stew on the side of the stove until tender. (3) Moisten with stock, add the cubed potatoes, bring to the boil and skim. (4) Simmer until tender, pass through a strainer, reboil, remove any scum, correct seasoning and consistence and serve.

Quantity sufficient for 4 persons.

Fish

493. There are three classes of fish :—

Oily fish such as salmon, herring, mackerel, and eels. The flesh is dark, because the oil is distributed round the muscle fibres ; it is richer and more nutritious than the flesh of white fish, but more difficult to digest.

White fish such as cod, whiting, halibut, soles, and plaice. The oil or fat in these fish is stored to a large extent in the liver ; so the flesh is light, digestible and white. White fish should always be selected for invalids.

Shell-fish such as oysters, lobsters, and crabs. With the exception of the oyster, these are less digestible than the other classes.

Fish must be fresh and well cooked. Stale or under-cooked fish is both unpalatable and dangerous.

Fresh-water fish must be cleaned at once, for if it is left long uncleaned it will develop a muddy flavour. If the fish smells at all muddy, it should be washed or even soaked in salted water. Early cooking is important. When the fish has been kept on ice staleness is not easily detected, but the apparently fresh condition changes rapidly on removal from the ice. White fish are best poached, steamed, grilled, fried or sauté; oily fish should be grilled, braised or boiled. All fish should be washed in salt and water, except dried and smoked fish, which should be wiped with a damp cloth, and salt fish, which require soaking in cold water to extract some of the salt. The eyes, gills and scales should be removed from all whole fish, the fins and tail trimmed, and the inside thoroughly cleaned and wiped.

494. Fish stock.

Fish bones and trimmings	8 oz.	Water	2 pints
Onion	1	Margarine	½ oz.
Lemon juice		Faggot	1
Salt	pinch		

(1) Blanch and refresh the fish bones and trimmings. (2) Place, together with a small faggot, juice of ½ a lemon, margarine, salt and onion sliced thinly, in a stewpan. (3) Cover with a lid and gradually heat for 10 minutes. (4) Run off the resultant essence for use when finishing the sauce. (5) Cover the bones with water, bring to the boil, skim, simmer for 15 minutes and strain through muslin.

495. Filleting fish.—For purposes of filleting, fish can be divided into two classes :—

Long such as cod, hake, haddock, whiting, ling, coalfish and bream.

Flat such as halibut, turbot, brill, plaice, lemon or Dover sole, megrims, witches, dabs or flounders.

(1) Wash and scale the fish. (2) Cut down each side of backbone, working from head to tail. (3) Cut away the fillet by keeping the knife under the flesh and close to the bone.

For flat fish start at the head and work outwards to the edge of the fish—turning over and repeating the process for the other side. For long fish work downwards, finishing at the tail.

Where it is necessary to skin flat fish (sole) this should be done beforehand, by raising the skin near the tail with a knife and pulling it off by hand, taking care to keep the fish flat on the table.

496. Baked fillets of fish.—(1) Place the required number of fillets in a buttered baking tray, moisten with fish stock and lightly sprinkle with salt. (2) Place a piece of greased paper over the fish and bake in a moderate oven for 15 minutes.

497. Boiled fish.—(1) Clean the whole fish, remove its fins, and soak it in salt water for 1 hour. (2) Place it in a fish kettle and cover with cold salt water; add a little lemon juice or vinegar and bring slowly to the boil. (3) Poach until the fish is firm and bone is easily removed. (4) Drain the fish well and serve with boiled potatoes, and parsley, caper or a similar sauce. (5) Cut fish should be placed in boiling salt water to set the fish, and proceed as above.

498. Fried fish.—(1) Wash the fish and dry well. (2) Season with salt and pepper. (3) Pass through frying batter and place in deep hot fat. (4) Allow to cook until it is a golden brown. (5) Remove from fat, drain well and serve.

499. Grilled sole.—(1) Clean, remove the black skin and well wash the fish. (2) Make a few incisions on the thick part of the fish to allow heat to penetrate. (3) Season with salt and pass through flour; then place on a hot grill, previously greased, skin side down, over the fire. (4) When moisture percolates, turn over, brush the grilled side with melted margarine, allow to colour, brush over again with melted margarine, remove and serve.

When cooked the fish should be firm and leave the bone (centre incision).

500. Fish cakes.

Cooked fish	6 oz.	Pepper
Mashed potatoes	6	Salt

(1) Flake the fish and add to dry mashed potatoes. (2) Add the seasoning and heat to boiling-point. (3) Lay out on a clean tray and allow to cool. (4) Mould into flat round cakes, dust lightly with flour and fry in deep boiling fat. (5) When cooked, drain carefully and serve.

Quantity sufficient for 3 persons.

501. Fricassee of fish.—White fish—whiting, turbot, brill or eel—should be used.

(1) Clean, wash, trim and cut into 3-ounce pieces. (2) Place into a buttered and seasoned pan, season, add a little lemon juice and barely cover with fish stock. (3) Cover with a greased paper, carefully bring to the boil and poach for 8 to 10 minutes, until fish is firm (4) Remove fish into another pan, cover with paper and keep warm. (5) Reduce the essence, add an equal quantity of white sauce, and reduce sufficiently to coat the back of a spoon. (6) Meanwhile place 2 yolks of egg per pint of sauce into a basin with 1 oz. of butter, a little lemon juice and a pinch of cayenne pepper; mix, work on the boiling sauce and return to the saucepan. (7) Bring

to the boil *but do not continue boiling*; correct seasoning and consistence and pass through muslin. (8) Border a dish with braised rice; heat up the fish and place it in the centre of the dish. (9) Sauce over and serve.

Braised rice.

(1) Chop a small onion finely, stew in margarine without taking colour, add rice and heat through. (2) Add an equal quantity of fish stock and bring to the boil. (3) Cover with a lid and braise in a moderate oven for 18 minutes. (4) Stir in a few pieces of margarine with a fork and correct the seasoning.

502. Fish Soufflé.

White fish (whiting, turbot or brill) ...	10 oz.
White of egg	3
Butter	2 oz.
White sauce	½ pint
Cream	1 gill

(1) Free the cooked fish from skin and bone and pound in a mortar with a pinch of coarse salt and pass through a fine sieve. (2) Return to the mortar and work in one white of egg, the butter and the white sauce. (3) Put the mixture in a saucepan and place on ice to chill. (4) Gradually work in the cream, stirring vigorously with a wooden spoon. (5) Fold in the loosely whipped white of egg and correct the seasoning. (6) Three-parts fill a greased mould and tap down on a table so that the mixture goes to the bottom. (7) Place the mould in a shallow pan filled with boiling water to half the height of the mould; simmer until the mixture reaches the top of the mould. (8) Place a buttered paper on top and place into a slow oven for approximately 10 minutes.

Quantity sufficient for 4 persons.

503. White fish pudding.

Cooked fish	6 oz.	Nutmeg
Soft breadcrumbs	1 oz.	Mace (a pinch)
Egg	1	Salt
Butter	2 oz.	Pepper

(1) Chop or mash the fish, warm it up in the butter and add the breadcrumbs, previously soaked in ½ gill of milk or cold stock. (2) Season with salt, pepper, a pinch of mace and a grate of nutmeg, then add the beaten egg and well mix. (3) Steam in a buttered mould for 20 minutes; or bake in a tin, buttered and coated with breadcrumbs, for 15 minutes.

Quantity sufficient for 2 persons.

Meat

504. Boiled salt beef.—(1) Place the meat in a stewpan, cover with water, boil and skim. (2) Simmer until cooked.

505. Mince.

Cold meat scraps	A little dripping
A small onion	Brown sauce

(1) Finely chop the onion and fry in the dripping ; add the diced meat and sweat slowly on the end of the stove. Allow the meat to heat through. (2) Season, add the sauce, heat up and serve. (3) Snippets of fried bread, or a poached egg, may be served on the mince.

Poultry and Rabbit

506. Roast fowl.—(1) Pluck, draw, wipe and singe the fowl. (2) To draw the fowl, lay it breast downwards and cut down the back, neck and round the head and remove the crop. (3) Loosen the entrails carefully from the neck. (4) Cut off and remove the vent. (5) *Special care must be taken to avoid breaking the gall-bladder*, for this would impart a very bitter taste to the flesh and liver. (6) Cut off the neck at the base of the spine. (7) Singe and wipe inside and out. (8) Dip the scaly parts of the legs in boiling water for a few moments and remove the outer skin with a cloth ; cut off the claws, the tips of the pinions and the points on the winglets. (9) To truss, pass the string through the elbow, through the carcase and through the other elbow ; then through the winglets and point of winglet, and through the second winglet ; tie off where string was first inserted. (10) Pass a second string through small cavity in the carcase about 2 inches from the vent ; then through the carcase. (11) Pass the string over the drumsticks through the bottom of the breast and tie off where the string was first inserted. (12) Sprinkle a little salt inside the carcase, place the bird on its side in a roasting tin, baste with dripping and cook in a hot oven for 10 minutes. (13) Turn the bird over on the opposite side for 10 minutes and finally place it on its back to complete the cooking. (14) Baste from time to time. (15) Hold up, feet downwards, and if the blood runs out white the bird is cooked.

The average cooking time for a $2\frac{1}{2}$ lb. bird is 40 to 45 minutes. This will produce six diets—*i.e.* 2 legs, 2 wings and 2 breasts.

To reheat a cooked fowl, wrap it in buttered greaseproof paper and pass through an oven for approximately 15 to 20 minutes. If one portion is required, cut the portion and reheat as above.

507. Boiled chicken.—(1) Prepare the chicken as for roasting. (2) Place in a saucepan, cover with cold water and bring to the boil ; skim ; wipe the sides of the pan and add approximately $\frac{1}{4}$ oz. salt, 2 carrots, 1 onion, a little white of a leek, a faggot and 6 peppercorns. (3) Simmer slowly

until cooked (about 1½ hours). (4) When keeping hot, place in a small quantity of the liquor. This will also prevent drying. (5) Pass the remainder of the stock through muslin, make a white chicken sauce and boil out for 20 minutes. (6) Skim, pass through muslin, reduce to cover the back of a spoon, work in a little cream (if available) and correct the seasoning. (7) Remove the string and skin, cut into portions and sauce over. If the chicken is served plain, pour over a little of the liquor.

508. Stewed rabbit.

Rabbit	1	Margarine	1 oz.
Onion	1	Flour	1 oz.
Salt and pepper		A little parsley	
		Faggot	

(1) Cut the rabbit into joints, blanch and refresh. Cover with cold water, add the onion cut into quarters, season and bring to the boil. (2) Add faggot, skim carefully and simmer for 1 hour. (3) Melt the margarine in a stewpan, add the flour, cook until sandy in texture; then allow to cool slightly. (4) Strain the liquor off the rabbit, and add slowly, making a white sauce. Season correctly and pour over the rabbit. (5) Simmer gently until the rabbit is cooked (approximately ½ hour); then garnish with coarsely chopped parsley.

2½ lb. rabbit—sufficient for 6 persons.

Gravy

509. Gravy.—A little hot gravy should always be poured round each portion of roast meats or poultry.

(1) After roasting, set the roasting tin on the stove and allow the moisture to evaporate until a sediment forms on the bottom; run off the fat and set it aside. (2) Moisten the pan with the required amount of beef, mutton, veal or chicken stock (1 tablespoonful per portion), boil up, correct colour and seasoning, pass through muslin, allow to stand for a few moments, remove fat from surface, and keep hot.

Vegetables

510. Fried potatoes.—(1) Wash, peel and cut into thick strips. (2) Rewash, drain and blanch in hot deep fat, deep enough to cover potatoes. Remove and drain. (3) Reheat the fat and fry potatoes until crisp on the outside (4) Sprinkle with salt and drain on a cloth.

511. Braised cabbage.

Cabbage	1	Onion	1
Carrot	½	A little salt	
Brown sauce	¼	Bacon trimmings ...	2 oz.
Stock	¼	Stock-pot fat	2 oz.

(1) Clean the cabbage, cut into quarters, cook in boiling salted water for 10 minutes; then drain in a colander. (2) Peel and slice carrot and onion, place in a saucepan with the bacon trimmings and fry lightly. (3) Place the cabbage on the sliced carrots, etc.; half cover with stock and dripping, cover with greased paper and bring to the boil. (4) Cover with a lid and braise in the oven for approximately 1 hour. (5) Remove cabbage, strain the stock, remove all fat, reduce the stock, add the brown sauce and serve with the cabbage.

Allow $\frac{1}{4}$ lb. cabbage per person.

512. Buttered carrots.—Peel, wash and cut into sections. (2) Place in a saucepan, add 2 or 3 nuts of margarine and a pinch of salt and sugar, barely cover with water, and bring to the boil. (3) Cover with a lid and cook until tender. (4) Remove the lid and allow liquor to evaporate before serving.

Pastry, Puddings and Porridge

513. Pastry.—Good results in making pastry can only be attained by attention to detail. First, the flour should be sifted through a sieve, and then baking-powder should be added. Baking-powder is a preparation of an acid and an alkali which gives off carbon dioxide on the addition of water. The air and the gas in the pastry expand when it is heated; it is this expansion which makes the pastry light. Cool hands are essential, and all ingredients must be carefully weighed.

Proportions: $\frac{1}{2}$ lb. flour, 3 oz. lard or butter, $\frac{1}{2}$ teaspoonful of baking-powder, 1 gill cold water.

National flour should not be sifted but aerated with the fingers. In the case of ordinary flour, sift it with the salt on a marble slab, rub in the fat until the mixture is sandy in texture, make a bay and add the water. Lightly mix with the hands to a fairly stiff dough; then allow the paste to rest in a cool place.

Fruit pies.

(1) Roll out the paste to approximately $\frac{1}{6}$ inch in thickness to the size of the pie-dish or plate. (2) Wet the edges of the dish, cover with paste and trim any rough edges. (3) Brush over with a little water or milk, sprinkle with sugar and allow to rest. (4) Place in a hot oven and bake for approximately 40 minutes until paste and fruit are cooked.

Meat pies.

(1) Roll out the paste to approximately $\frac{1}{4}$ inch in thickness, slightly larger than the size of a pie-dish. (2) Cut a strip approximately $\frac{1}{2}$ inch wide, wet the edge of the pie-dish, place a strip of paste round, moisten it, then cover with the remainder of the paste. (3) Press edges together, trim off any rough

edges, brush over with a little milk and decorate the top. (4) Brush over again and allow to stand for 20 minutes. (5) Bake in a moderate oven for 2 to 3 hours, then fill up with very hot gravy before serving.

514. Suet pudding.

Flour	1 lb.	Baking-powder ...	1 oz.
Suet	½ lb.	Salt	½ oz.
Water to mix			

Quantity sufficient for 4 persons.

(1) Remove skin from the suet and chop very finely ; put it into a basin with the flour, baking-powder, and salt ; mix thoroughly and add enough water to give a light consistence. (2) Fill into small greased moulds, cover each with greased paper, and steam for 45 to 60 minutes.

515. Rice pudding

Rice	2 oz.	Sugar	1 oz.
Milk	1 pint		

(1) Wash the rice, put it in a saucepan with the milk and simmer until the milk is thick ; then add the sugar. (2) Pour into a lightly buttered pie-dish and bake in a moderate oven for 20 to 30 minutes.

Lemon, cinnamon, nutmeg and other spices may be used as flavourings. These should be added to the mixture before baking. A thin piece of lemon rind boiled in the milk and removed before baking gives excellent results.

Quantity sufficient for 2 persons.

516. College pudding.

Flour	8 oz.	Suet	6 oz.
Currants	4 oz.	Eggs	2
Breadcrumbs	8 oz.	Milk for mixing	
Sugar	2 oz.		

Quantity sufficient for 4 persons.

(1) Mix all dry ingredients thoroughly ; moisten with beaten eggs and a little milk. (2) Three parts fill greased moulds with the mixture, cover with greased paper and steam for 1½ hours. (3) Serve with a suitable sauce.

517. Custard pudding.

Egg	1
Milk	12 oz.
Sugar	½ oz.
Little vanilla essence or grated nutmeg if desired.	

(1) Beat the egg, add to it the milk and sugar (and vanilla essence if required), and stir briskly until the sugar is dissolved. (2) Pour the mixture into a buttered pie-dish or pudding tin,

grate a little nutmeg over if required, and bake in a moderate oven for about 20 minutes. (3) Serve either hot or cold.

The same ingredients can be put into a greased basin and steamed or placed in a double saucepan and boiled.

Quantity sufficient for 2 persons unless on a milk diet.

Alternative ingredients.

Dried or preserved egg ...	2/5 oz.	Sugar	½ oz.
Cold water	1 oz.	Flavourings as above if desired	
Milk	12 oz.		

(1) Reconstitute the eggs by putting them into a basin with the cold water, stirring thoroughly. (2) Allow the eggs 3 hours to absorb the water. (If required for immediate use the eggs may be soaked in tepid water for about 10 minutes.) (3) When ready beat them briskly, add the milk and sugar, and vanilla essence if required, stir well until the sugar is dissolved, pour the mixture into a buttered pie-dish or pudding tin, sprinkle over with grated nutmeg, and cook in a slow oven until set. (4) If the oven is too hot the custard will spoil by curdling. (5) Serve either hot or cold.

518. Oatmeal porridge.

Oatmeal	1 oz.	Cold water	10 oz.
Milk	4 oz.	Salt to taste	

(1) Bring the water to the boil and while it is boiling sprinkle in the oatmeal, adding the salt, stirring briskly to prevent lumps forming. (2) Cook gently for about 1 hour. (3) Stir all the while to prevent burning. (4) Serve with cold milk and sugar if required.

Quantity sufficient for 1 person.

Sauces

519. White sauce and brown sauce form the base of most sauces. They are, therefore, often described as the foundation sauces.

520. White sauce.

Milk	1 pint	Butter	3 oz.
Flour	4 oz.	Salt to taste	

(1) Melt the butter in a saucepan; then add the flour, stirring to a smooth paste, taking care to keep the mixture from sticking to the side of the saucepan. (2) Cook without colouring until it attains a sandy texture, then allow to cool slightly. (It is technically known as a white roux.) (3) Boil

the milk and add gradually to the roux, mixing well to prevent lumpiness. (4) When all the milk is absorbed add the salt and boil gently for half an hour.

It should not be necessary to pass this sauce if it is correctly mixed at the beginning. More milk or flavouring is added as required.

Quantity sufficient for 8 portions.

521. Brown sauce.

Stock	1¼ pints	Dripping	2 oz.
Onion	1	Flour	1½ oz.
Carrot	1	Salt and pepper	

(1) Peel the onion, scrape the carrot, and dice. (2) Melt the dripping in a pan, add the vegetables and flour, and fry to a rich golden brown. (3) Add the stock and bring to the boil; skim, and simmer for 20 minutes. (4) Strain, correct the seasoning, reboil, skim and use as required.

Quantity sufficient for 8 portions.

522. Bread sauce.

Milk	2 pints	Margarine	2 oz.
Breadcrumbs	8 oz.	Few cloves	
Onions	4	Salt and pepper	

(1) Place the milk in a saucepan with the onions and cloves, and bring slowly to the boil. (2) Simmer for 15 minutes. (3) Remove the onions and cloves and add the breadcrumbs. (4) Stand on a warm part of the stove for 15 minutes, to allow the breadcrumbs to absorb some of the milk. (5) Bring to the boil again and stir in the margarine.

Quantity sufficient for 16 portions.

523. White fish sauce.

Margarine	2½ oz.
Flour	2½ oz.
Fish stock	2 pints

This is the foundation for all fish sauces. It is cooked in the same way as white sauce (para. 520).

Quantity sufficient for 16 portions.

CHAPTER 61

INVALID COOKERY

524 The following recipes are intended mainly for sick persons. The seasonings and flavourings recommended may have to be reduced or omitted for those with weak or impaired digestions.

525. Cereals.

Arrowroot.

Arrowroot	½ oz.
Milk	10 oz.
Sugar	½ oz.

(1) Mix the arrowroot with 2 oz. of cold milk, and stir it slowly into the remaining 8 oz. of boiling milk. (2) Simmer for a few minutes, stirring briskly all the time. (3) Add the sugar, a pinch of cinnamon or a little brandy and serve.

Water may be substituted for milk.

Quantity sufficient for 1 person.

Gruel.

Oatmeal	1 oz.
Milk	1 pint
Sugar	½ oz.

(1) Mix the oatmeal with a little of the milk; boil the remainder. (2) When boiling, pour it on the oatmeal. (3) Return the mixture to the saucepan. (4) Boil for 10 minutes, add the sugar. (5) Serve very hot.

Quantity sufficient for 1 person.

Porridge.

Oatmeal (medium)	2 oz.
Water	1 pint
Salt	

(1) Take freshly drawn cold water, add salt, and bring to the boil. (2) Sprinkle in the oatmeal, stirring all the time to prevent lumps forming. (3) Boil, stirring for the first 5 or 6 minutes until the meal is swelled. (4) Simmer for at least 1 hour, stirring occasionally. (5) If necessary, add more boiling water, as the porridge should be of a pouring consistency.

Quantity sufficient for 1 person.

526. Milk dishes.

Junket.

Milk	10 oz.	Rennet	1 teaspoonful
Sugar	½ oz.	Flavouring essence	2 drops or pinch of nutmeg

(1) Warm the milk to 98° F., and add the sugar. (2) When dissolved, pour into a small bowl or dish. (3) Stir in the rennet and, if desired, the flavouring essence. (4) When set, remove to a cool place.

Grated nutmeg may be sprinkled over the surface if preferred to the flavouring essence.

Quantity sufficient for 1 person.

Whey.

Milk	½ pint
Lemon	½
Sugar	½ oz.

(1) Bring the milk to the boil, stir in the strained lemon juice, and add the sugar. (2) Simmer for a few minutes until the curd separates, allow it to cool, strain off the whey and serve.

Quantity sufficient for 1 person.

Bread and milk.

Bread	4 oz.
Milk	10 oz.
Sugar	½ oz.

(1) Remove the crust from the bread, cut into medium-sized dice, put them in a basin, pour on the hot milk, and add the sugar if desired. (2) Place a small plate on the top of the basin and leave to steep for 10 minutes before serving.

Quantity sufficient for 1 person.

Proprietary foods.

Benger's Food, Horlick's Malted Milk, Mellin's Food and other proprietary foods should be prepared according to the directions printed on the labels.

527. Meat preparations.

Beef juice.

Beef steak	8 oz.
Pinch of salt	

(1) Place a lean beef steak on a grill over a clear hot fire; warm it through only, without browning the outer surface. (2) Place it on a warm plate and cut it into strips. (3) Press the beef on a sieve, or into a small conical strainer with pressure, when no small meat-press is available; add a little salt and serve with a small piece of toast.

The above quantity of meat would produce about ½ gill of beef juice.

Per person.

Beef tea.

Lean beef	... ...	12 or 8 oz.
Salt ...	... ...	pinch
Cold water	... ...	1 pint

First method.—(1) Remove the fat, skin and sinews from the meat, shred the meat finely, put it into a stewpan with the cold water and salt, and let it soak for 15 minutes. (2) Place the stewpan over moderate heat for 45 minutes, stirring frequently with a fork. (3) Strain through a fine strainer. (4) Serve hot.

Second method.—(1) Remove the fat, sinews and skin from the meat and mince the meat finely. (2) Place it in a jar with the water and salt; stand the jar in a saucepan of boiling water or put it in a slow oven for 2 or 3 hours. (3) Strain; remove carefully any fat with kitchen paper. (4) Serve hot.

Chicken tea.

(1) Cut an ordinary-sized chicken into pieces, breaking all the bones. (2) Put it in an earthenware jar with 2 pints of cold water and a little salt. (3) Cover the jar tightly and stand in a saucepan of boiling water. (4) Simmer (but do not boil) for 4 or 5 hours and then strain.

All per person.

528. Egg dishes.

Egg flip

Egg	... ...	1
Sugar	... ...	$\frac{1}{4}$ oz.
Port, sherry or brandy (if ordered)	...	$1\frac{1}{2}$ oz.

(1) Place the yolk of the egg and the sugar in a basin, whisk until creamy, and add the wine. (2) Beat the whites to a stiff froth and stir in lightly. (3) Pour into a tumbler, and serve.

All per person.

Egg nog.

Egg	1	Sugar	$\frac{1}{2}$ oz.
Milk	10 oz.	Brandy or whisky ...	$\frac{1}{2}$ oz.

(1) Place in a basin the egg and sugar; beat them well together. (2) Stir in the brandy or whisky. (3) Pour into a tumbler, fill up with hot milk, mix well, and serve.

Poached egg.

Buttered toast	... ...	1 round
Egg ...	... ...	1
Salt and vinegar	... ...	

(1) Butter the toast and keep it hot. (2) Place the egg in boiling water for a second to release the white from the shell, and then break the egg into a cup. (3) Slip the egg into a

pan filled with water, keeping to the side of the pan; bring to the boil, cover with a lid and allow to stand for 3 minutes, without boiling, until set. (4) Remove the egg from the water carefully with an iron spoon and place it in cold water. (5) When required place the egg in hot salty water to heat through; remove, drain and serve on the toast.

529. Invalid drinks.

Albumin water.

(1) Whisk up the whites of 2 eggs to a stiff froth, and add these with a pinch of salt to a pint of cold boiled water, mixing them well. (2) Strain before giving to the patient.

A flavouring of lemon juice may be added, unless unsuitable for the particular case.

Barley water

Barley	1 oz.	A few pieces of lemon rind	
Sugar	1 oz.	Lemon juice ...	1 teaspoonful
Water	$2\frac{1}{2}$ pints		

(1) Wash and soak the barley for half an hour, cover with cold water, blanch and refresh. (2) Return to the saucepan, cover with water, add the lemon rind, and simmer until the liquid is reduced to about two-thirds of its original volume. (3) Strain; add the sugar and lemon juice. (4) As barley water will keep only for a few hours it should always be put in a cool place and never reheated. It is a nourishing as well as a cooling drink.

5 persons according to diet.

Rice water.

Carolina rice...	2 oz.
Sugar...	1 oz.
Water	$2\frac{1}{2}$ pints

(1) Wash the rice thoroughly in cold water. (2) Soften by steeping it for 3 hours in a pint of water kept at tepid heat. (3) Boil slowly for an hour, and strain. (4) Flavour with lemon rind or orange juice. (5) Sugar may be added if required.

5 persons according to diet.

Toast water.

Stale bread	4 oz.
Sugar...	$\frac{1}{4}$ oz.
Water	$1\frac{1}{2}$ pints.

(1) Cut the bread into slices. (2) Toast to a very dark brown—but do not burn, for this gives the water an unpleasant flavour. (3) Place the slices in a jug with the sugar, pour on the boiling water, and cover closely. Stand in a cool place, and serve when cold.

Portion according to diet.

CHAPTER 62

MISCELLANEOUS HINTS FOR COOKS

530. Points to remember.—Here are ten good rules for all cooks :—

(*a*) Maintain a high standard of personal cleanliness and smartness, paying particular attention to hands and finger-nails.
(*b*) Keep all kitchen utensils spotlessly clean.
(*c*) Cook tidily, using as few utensils as possible.
(*d*) Always use steam in preference to boiling. Only boil when steam is not available.
(*e*) Keep a sharp eye on all pots, pans and ovens in use. Really good cooking demands constant attention.
(*f*) Never slam an oven door.
(*g*) Never add new stocks of flour, tea, potatoes and similar commodities to stocks in hand.
(*h*) Master the directions before beginning any recipe.
(*i*) Always practise strict economy. To waste food is a crime.
(*j*) A well-conducted kitchen requires a very small receptacle for refuse.

531. Equivalents.—If scales are not available, quantities have to be estimated by other means. The following table of equivalents should be memorized.

Coins.

3 pennies	=1 oz.
12 pennies	=¼ lb.
1 florin and 1 sixpenny bit	=½ oz.
1 halfpenny and 1 threepenny bit	=¼ oz.

Food.

1 egg	=2 oz.
1 piece of butter the size of an egg	=2 oz.
1 piece of suet the size of an egg	=2 oz.
1 teacup of flour	=4 oz.
1 breakfast cup of flour	=8 oz.
1 heaped tablespoonful of light material	=1 oz.
1 flat tablespoonful of heavy material	=1 oz.

Measures of capacity.

2 teaspoonfuls	=1 dessertspoonful.
4 teaspoonfuls	=1 tablespoonful.
1 tumbler	=½ pint.
2 wineglasses	=1 gill.

532. Baking in gas-stoves.—For baking cakes and pastry in a gas cooking stove, the oven must be thoroughly heated before operations begin. When the oven has reached the proper temperature, the gas should be lowered until the flame is scarcely more than ½ inch in length. If the gas is left too high while the cakes are cooking, the heat is concentrated on the underside of the baking tins, thus hardening the cakes too rapidly and probably burning them.

533. Baking powder.—*Recipe No.* 1 (for general use): 1 lb. bicarbonate of soda, 2 lb. cream of tartar, 1 lb. ground rice. *Recipe No.* 2 (for cakes): 1 lb. bicarbonate of soda, 1½ lb. cream of tartar, ¼ lb. tartaric acid. *Recipe No.* 3 (for self-raising flour): 40 lb. flour, 8 oz. bicarbonate of soda, 4 oz. tartaric acid, 6 oz. cream of tartar.

534. The Aymard milk-sterilizer.—To sterilize milk with the 6-gallon tin sterilizer:—

Pour water into the outer pan until it reaches the level at which it will run out of the tap; turn off the tap; light the fire.

Remove the two lids; pour the required quantity of milk (preferably already strained) into the milk chamber.

Replace the two lids; insert the thermometer through them. When the milk reaches a temperature of 195° F. (in about 20 minutes), open the furnace door, and keep the milk at that temperature for 5 minutes; then rake out the fire. The milk is now sterilized.

To cool the milk, remove the thermometer and the outer lid; do not touch the inner lid, for a scum will form if it is removed, even for a moment. Insert a hose-pipe into the outer pan, and turn on the tap. (If running water is not available, fill from a bucket.)

Replace the thermometer in the inner lid, and allow the milk to cool to 100° F.; then remove the thermometer, clean it, and put it in a position of safety.

During heating and cooling the milk should be stirred every 3 or 4 minutes by drawing the handle of the stirrer up and down once or twice.

The milk is now ready to serve out. It must not be stored in the sterilizer. Ladle it out into the vessels for distribution or for storage in the canteen, covering with a clean cloth to prevent unnecessary exposure to the air. To get all the milk out of the sterilizer, lift it right out of the pan, and pour through the spout.

To clean the sterilizer fill the milk chamber with cold water; let it stand for a short time; then empty, wipe out and dry. The water in the outer pan can be used again without refilling.

Always leave the lid off the sterilizer until required for use again; use no sand for cleaning; soda is unnecessary.

If no thermometer is available when heating the milk, watch for steam coming out of the lid and spout; this happens after 20 minutes; it means that the temperature of the milk has reached 195° F. Steam does not escape earlier, because the milk chamber is then acting as a condenser.

CHAPTER 63

HOSPITAL DIETARY

535. The articles of food that may be ordered for patients in a military hospital are laid down in Allowance Regulations. This allows the O.C. the hospital to construct varied menus for each class of diet.

At least two weekly menus, to be used alternately, should be prepared for ordinary diet, and further variety can be introduced by taking advantage of the seasonal prevalence of fruit and vegetables. The average cost for each patient should be kept at about the same figure throughout the year.

536. The above menus are based on the needs of the ordinary patient. If it is thought desirable to increase the diet for any special case, additional articles, as laid down in Allowance Regulations, may be ordered on the diet sheet and diet summary as "extras." This also applies to malt liquors, wines, lemonade and the like. Extras should not be issued for patients taking their meals in the dining-hall.

When a patient's condition is such that it is considered inadvisable to place him on any diet, the words "No diet" are entered on the diet sheet and diet summary. Such food as he may require is ordered as extras, and specially prepared in the hospital kitchen according to instructions.

APPENDIX I

RESCUE FROM FIRE AND WATER

Fire

Soldiers are among the first to offer—and to be asked for—help in putting out fires, and in rescuing people who may be trapped. Attention to the following points will increase the efficiency, and decrease the risk, of the rescue.

The Approach

1. In searching a burning house, start at the top. This is the most difficult and dangerous job : if it is to be done, it must be done early ; afterwards it may be too late.

2. To avoid heat and smoke, lie down and crawl, keeping the head low ; remember that hot air rises.

3. Doors and windows should be kept closed, because, if a fire gets less air, it does not burn so fast.

4. It is safer to make a rescue from outside through a window than by using passages and stairs.

5. When passages and stairs have to be used, and also when crossing rooms, keep near the walls, because there the floor has more support.

6. If the door of a burning room opens outwards, control its swing by placing your boot a few inches from the closed door. Then open it slowly and steadily. In this way the door acts as a shield for your body against heat and smoke coming out. Once the door is open, get down and crawl.

The Rescue

1. If the person to be rescued has his clothing on fire, make him lie down. Hold a blanket in front of you as you approach him ; throw the blanket over him, and roll him in it on the floor. This keeps away air from the burning clothing, which therefore can no longer burn.

2. If your own clothes catch fire, put your hand over your mouth, lie down and roll.

3. If the person to be rescued is unconscious, lay him face upwards, and tie his wrists together. Then kneel astride his chest, raise his arms, and put your head through the loop formed by his arms. Then crawl forward, and he will be dragged along beneath you by his tethered wrists round the back of your neck.

4. If you have to drag him down stairs, disengage yourself from the loop ; place him face upwards, head first to the stairs. Then start to crawl down the stairs, in front of him, backwards, guiding and easing his descent by your hands placed under his armpits.

Carbon Monoxide Fumes

The Service respirator affords no protection against carbon monoxide. This gas is formed in burning buildings and may cause the occupants or their rescuers to become unconscious. When entering a place where there is reason to suspect its presence in dangerous quantities, a life-line should be worn—and, if possible, a self-contained oxygen-breathing apparatus.

A useful rescue apparatus can be improvised by removing the container from a respirator and fixing a hose-pipe into the lower end of the connecting tube ; the other end of the hose-pipe is left in the fresh air. This apparatus can be worn for a quarter of an hour.

When no such equipment is at hand, first breathe deeply for a minute or two, and then try to hold your breath while in the poisonous atmosphere.

A wet cloth tied over the mouth will reduce the choking effects of smoke.

Water

The R.A.M.C., which usually does well in competitive Army swimming, gives plenty of encouragement to swimmers. It is worth while to become a good swimmer, both for your own safety in emergency, and to be able to rescue the drowning should the occasion arise.

Therefore practise often in the bath. Practise saving the dummy, both from the surface and from the bottom ; practise towing it, not merely for one length but for much longer distances. Then practise on your friends : first let them pretend to be unconscious ; then let them struggle violently.

When you can do all these exercises confidently, do them in your clothes. When an emergency arises—for instance ice breaking on a frozen lake—you will not be wearing bathing slips. You must be able to swim a reasonable distance with all your clothes on, including overcoat and heavy boots.

The Approach

If water weeds are thick, swim on your back, using the legs almost entirely ; in this way you will avoid being entangled.

The Rescue

Come up to your man from behind.

1. *Drowning person quiet.*—Get him on his back ; support his head with one hand behind the ear on each side. Swim on your back underneath him ; hold his head as high as you can, for this reassures him, and speak gently some comforting words.

With children or light-weights a powerful swimmer can use one hand only, placing it behind the neck with the thumb behind one ear and the fingers behind the other. He thus has a hand free to swim faster, or to seize some rope or chain for getting out of the water. He can also change hands if he is getting tired ; or, with children, he can save two at once, one in each hand.

2. *Drowning person violent.*—Get him from behind with your arms round his chest, raising his arms at the same time ; then swim on your back. If he succeeds in clutching you, you must free yourself at all costs. Methods vary with the part seized, but you must act quickly. Do not hesitate to deliver a knock-out blow at the most vulnerable part of him within reach. If you are seized by both wrists, and are therefore powerless, you may be able to incapacitate him by bringing up your knee. If not, take a deep breath and sink together. He will not have taken a breath, and will quickly become unconscious. You can resuscitate him later.

A number of measures which may be practised when clutched are described in life-saving manuals.

When you have brought your man out of the water proceed with artificial respiration, if necessary, as described in Chapter 29.

APPENDIX II

INSTRUMENTS AND APPLIANCES

Aspirator.—An exhaust air-pump to draw off fluids.

Bougie.—A rod to dilate strictures. A urethral bougie is a half-curved tapering rod, made of metal; an œsophageal bougie is made of rubber or gum-elastic.

Catheter, urethral.—A tube which is passed through the urethra to withdraw urine from the bladder. Catheters are made in graduated sizes which are numbered; No. 1 is the smallest, No. 8 the one most often used. The catheter usually employed is the *Jacques' soft rubber catheter*, a flexible tube closed at the tip, with an eyelet or opening just behind the tip. If a Jacques' catheter will not pass, a *silver catheter* may be tried. This is a rigid half-curved metal tube, roughly like a small hockey-stick. In cases of prostatic enlargement a modified silver catheter, the *prostatic catheter* is used; it is more fully curved. Both these have a long thin wire, or stylet, within the tube, to keep the passage clear while the instrument is passed.

Gum-elastic and French olivary catheters are now seldom used. For women a short glass tube is employed.

Caustic-holder.—A small case, usually of vulcanite or silver, for holding caustic.

Clamps, stomach and intestinal.—Large clamps applied to the stomach or intestines in certain operations.

Clips, Michel's.—Small metal clips applied to the skin, as an alternative to sutures, to close an incision.

Curette, adenoid.—A sharp scraper, used to remove adenoid growths from the naso-pharynx.

Cystoscope.—An electrically-lit instrument for examining the interior of the bladder.

Director.—A flattened metal rod with a groove which forms a guide for the point of a knife.

Drainage tubes.—Rubber or glass tubes to drain operation wounds.

Elevator.—An instrument to raise depressed pieces of bone.

Forceps, bone.—Strong forceps for cutting bone.

Forceps, dental.—Powerful hinged pliers for extracting teeth.

Forceps, dissecting.—Plain forceps used for dissecting tissue (Fig. 69).

Forceps, dressing.—Forceps with scissor-handles, used for removing or inserting dressings (Fig. 69).

Forceps, Ferguson's clawed (*or lion forceps*).—Strong forceps with claws, used to grip bone when much force is needed.

Forceps, gouge.—Strong forceps, cutting at the points, to gouge bone.

Forceps, rib.—Forceps used to cut away portions of ribs.

Forceps, sinus.—Similar to dressing forceps, but with long slender blades (Fig. 69). It is used for enlarging the opening made into an abscess, or for applying dressings in a narrow cavity. It is not intended for lifting or holding objects.

Forceps, Spencer Wells (*or pressure forceps*).—Forceps to compress bleeding vessels; provided with a clip near the handle to keep the jaws closed when in action (Fig. 69).

Forceps, tissue, Lane's.—Forceps used for holding flaps at operations.

Forceps, tongue.—Long-handled light forceps which may be applied to the tongue to prevent it from slipping back and obstructing the airway during operations.

Guillotine, tonsil.—A small sliding knife, on the principle of the guillotine used in the French Revolution, for the removal of tonsils.

Insufflator.—A tube for blowing powder into cavities.

Irrigator or douche.—A metal or glass container to which a tube is attached fitted with a nozzle and stopcock; it is used to flush out wounds or cavities.

Laryngoscope.—An instrument for examining the throat and larynx.

Laryngotomy tubes.—Two curved, flattened silver tubes, one fitting inside the other, which are inserted through the skin into the larynx in certain operations.

Lenses, test.—Glasses of different strength for testing the eyes.

Ligatures and sutures.—Thread of sterilized silk, linen, cat-gut or tendon for tying blood-vessels and suturing tissues.

Needle, aneurysm.—A curved blunt needle with an eye near the point, for passing a ligature under an artery.

Needle, cataract.—A needle, without an eye, in a handle, used in the operation for cataract.

Needle-holder.—A strong forceps for holding a needle to put in stitches during operations.

Needles, surgical.—Curved and straight needles of various sizes. They may be round-pointed (like the domestic needle) or bayonet-pointed for piercing the skin.

Oesophagoscope.—An electrically-lighted instrument for examining the œsophagus.

Ophthalmoscope.—An instrument for examining the eyes.

Paul's tubes.—Glass tubes used to drain the intestine in certain operations.

Plates for fractures.—Plates of rustless steel or other metal which can be screwed into bone to keep broken pieces together and at rest.

Post-mortem case.—A case of instruments for post-mortem examinations.

Probe.—A silver rod for probing wounds (Fig. 69).

Retractor.—A broad blunt flat metal hook for holding back the edge of a wound during operation.

Retractor, amputation.—A special shield used, when bone is sawn in an amputation, to hold back the tissues and protect them from bone dust.

Retractor, self-retaining.—A double retractor, which does not have to be held by an assistant, used in abdominal operations.

Saw, electric.—An electrically-driven circular saw for cutting bone grafts.

Saw, amputation.—A saw used for cutting through bone.

Saw, Butcher's.—A framed saw (named after the inventor), used especially in the excision of joints.

Scalpel.—A short knife with a curved edge for cutting and dissecting.

Scoop or spoon.—A metal spoon for scraping tissue or extracting stones.

Shears, rib.—Powerful shears for cutting ribs.

Snare, wire.—A wire noose which can be drawn tight round a polypus or a tonsil.

Sound.—A name sometimes applied to a urethral bougie.

Spatula.—A piece of wood or metal resembling a broad blunt paper-knife, used to spread ointment, or to press down the tongue.

Speculum, eye.—An instrument used to keep the eyelids apart during eye operations.

Sterilizer.—An apparatus in which instruments or dressings are exposed to the heat necessary to make them surgically clean.

Stethoscope.—An instrument for listening to the sounds in the chest.

Stomach-tube.—A rubber tube for washing out or emptying the stomach.

Syringe.—An instrument of glass or metal, consisting of a plunger and a barrel, for injecting or withdrawing fluids. A *hypodermic syringe* is a graduated glass or metal syringe with a hollow needle, for injecting fluid beneath the skin. A *lumbar puncture syringe* has a long fine hollow needle for insertion into the spinal canal, either to withdraw fluid for examination or to introduce a spinal anæsthetic.

Syringe, enema.—A rubber pump, squeezed by hand, connecting two pipes, one with a nozzle to pass into the anus, the other with a pewter end to slip into the basin of fluid to be injected (Fig. 95).

Thermometer, clinical.—A closed glass tube, encasing a bulb and a fine column of mercury, graduated to register the temperature of the body (Fig. 81).

Tourniquet.—A band which can be tightened round a limb to compress an artery.

Tracheotomy tubes.—Silver or rubber tubes for insertion into the windpipe.

Transfusion apparatus.—Apparatus for the transfusion of blood or plasma.

Trephine.—A tubular saw used in operations on the skull.

Trocar and cannula.—A trocar is a short sharply pointed metal rod ; it is enclosed, except at its point, by a hollow metal tube, the cannula. The trocar, with the cannula attached, is used to pierce the skin and underlying tissues to withdraw fluid, which, when the trocar is removed, flows out through the cannula.

Truss.—A pad, retained by straps, which, through pressure exerted by a spring, prevents the bowel from protruding into a hernia.

Note.—Instruments and appliances authorized for military hospitals are shown in Regulations for the Medical Services of the Army. Lists of articles of field medical equipment are given in the Field Service Manual for the Medical Services of the Army.

APPENDIX III

TABLE OF FOODS IN SEASON WITH TIME REQUIRED FOR COOKING

Food	Season	Mode of cooking and average time required per lb.
	Meat, Poultry and Game	
Beef ...	All the year	Roast, 12–15 mins. Braised, 15–20 mins. Boiled, 15–20 mins.
Mutton ...	All the year	Roasted, 15 mins. Boiled, 18 mins.
Lamb ...	March to August ...	Roast, 15 mins.
Veal ...	March to August ...	Roast, 18 mins. Stewed, 20 mins.
Chicken ...	All the year	Roast, weight of 2 lb., 30 mins. Boiled, stewed, grilled.
Turkey ...	September to January	Roast, 15 mins.
Rabbit ...	September to March	Boiled, stewed, 12 mins.
Grouse ...	August to November	Roast, average time per bird, 20–25 mins.
Partridge ...	September to December	Roast, 20 mins. (per bird).
Pheasant ...	October to Jan. ...	Roast, 30–35 mins.
Snipe and Woodcock	October to December	Roast, 12–15 mins.
Hare ...	September to March	Roast, 1 hr. Stewed, 1½ hrs.
Venison ...	September to January	Roast, 8–10 mins.
	Fish	
Cod ...	September to March	Boiled, 12 mins. Baked, 12 mins.
Haddock ...	August to February ...	Baked, 10 mins. Fried, 5 mins.
Hake ...	Winter	Baked, 12 mins.
Halibut ...	Summer	Boiled, 10–12 mins. Baked, 10 mins.
Herrings ...	July to January ...	Grilled, 8 mins. Baked, 10 mins.
Mackerel ...	April to November ...	Baked, 10 mins. Grilled, 8 mins.
Plaice ...	May to January ...	Steamed, 8 mins., if filleted. Fried, 6 mins., if filleted.
Salmon ...	February to September	Boiled, 15 mins., if in steaks (when flesh is firm) (whole fish). Grilled, 10 mins., if in steaks.
Soles ...	All the year	Fried, 6 mins., if whole.
Whiting ...	May to January ...	Fried, 6 mins. if whole.
	Vegetables	
Asparagus	April to July	Boiled or steamed, 10–20 mins.
Beans, French	June to October ...	Boiled 15–20 mins.
Beans, runner	July to October ...	Boiled, 15–20 mins.
Beans, broad	July to August ...	Boiled, 10–15 mins.
Beetroots ...	September to March	Steamed—boiled, 1½ hrs. Baked, 2 hrs.
Broccoli ...	Autumn	Boiled, 10–20 mins.

Food	Season	Mode of cooking and average time required
	VEGETABLES—*continued.*	
Brussels sprouts	September to February	Boiled, 10–20 mins.
Cabbages ...	All the year	Boiled, if young, 10–15 mins.; if old, 20–35 mins.
Carrots ...	August to April ...	Boiled, young, ½ hr.; old, 2–2½ hrs.
Cauliflowers	Summer	Boiled, 15–20 mins.
Celery ...	October to February	Boiled or stewed, ½–1 hr.
Leeks ...	November to March	Boiled or stewed, 30–50 mins.
Lettuces ...	Summer	Boiled, 10 mins. Salad.
Onions ...	All the year	Boiled, 1–2 hrs. Baked, 2 hrs. Fried, 15 mins.
Parsnips ...	October to April ...	Boiled, 1–1½ hrs.
Peas ...	July to September ...	Boiled, fresh and young, 10–15 mins.
Potatoes (new)	May to August ...	Boiled or steamed, 20–25 mins.
Potatoes (old).	All the year	Boiled or steamed, ½ hr. Baked, 2 hrs. Fried, 15–20 mins. Sauté, 15 mins.
Savoys ...	October to March ...	Boiled, 20 mins.
Spinach ...	April to November ...	Boiled, 5–10 mins.
Tomatoes ...	June to December ...	Baked, 15–20 mins. Poached, 3 mins.
Turnips ...	August to March ...	Boiled, ½–1 hr.
Vegetable marrows.	August to October ...	Boiled, 15–20 mins.
	FRUIT	
Apples ...	September to April ...	Stewed, 10–20 mins. Pie, 30 mins. Tart, 15 mins. Pudding, 2 hrs. Fritters, baked, 20 mins.
Bananas ...	All the year	Compote, 5 mins. Fritters. Fruit salad.
Blackberries	September to October	Compote, 5 mins. Tartlets, 10–15 mins. Pudding, 2 hrs.
Cherries ...	June and July ...	Stewed, 5 mins. Tart, 45–60 mins.
Currants, red, black, white	July to September ...	Stewed, 10–20 mins. Tart, 45–60 mins.
Damsons ...	September and October	Stewed, 10–15 mins. Pudding, 2½ hrs. Tart, 45–60 mins.
Gooseberries	May to August ...	Stewed, 8–12 mins. Tart, 45–60 mins.
Lemons ...	All the year	Flavouring lemonade. Ice-cream.
Oranges ...	November to June ...	Fruit-salad. Ice-cream. Jellies.
Pears ...	September to March	Stewed, 30–40 mins.
Raspberries	June to August ...	Stewed, 3–5 mins. Tart, jelly, tartlets, ice-cream.
Rhubarb ...	March to June ...	Stewed, 6–15 mins. Tart, 45–60 mins.
Strawberries	June and July ...	Raw. Jelly. Cream. Ice-cream.

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